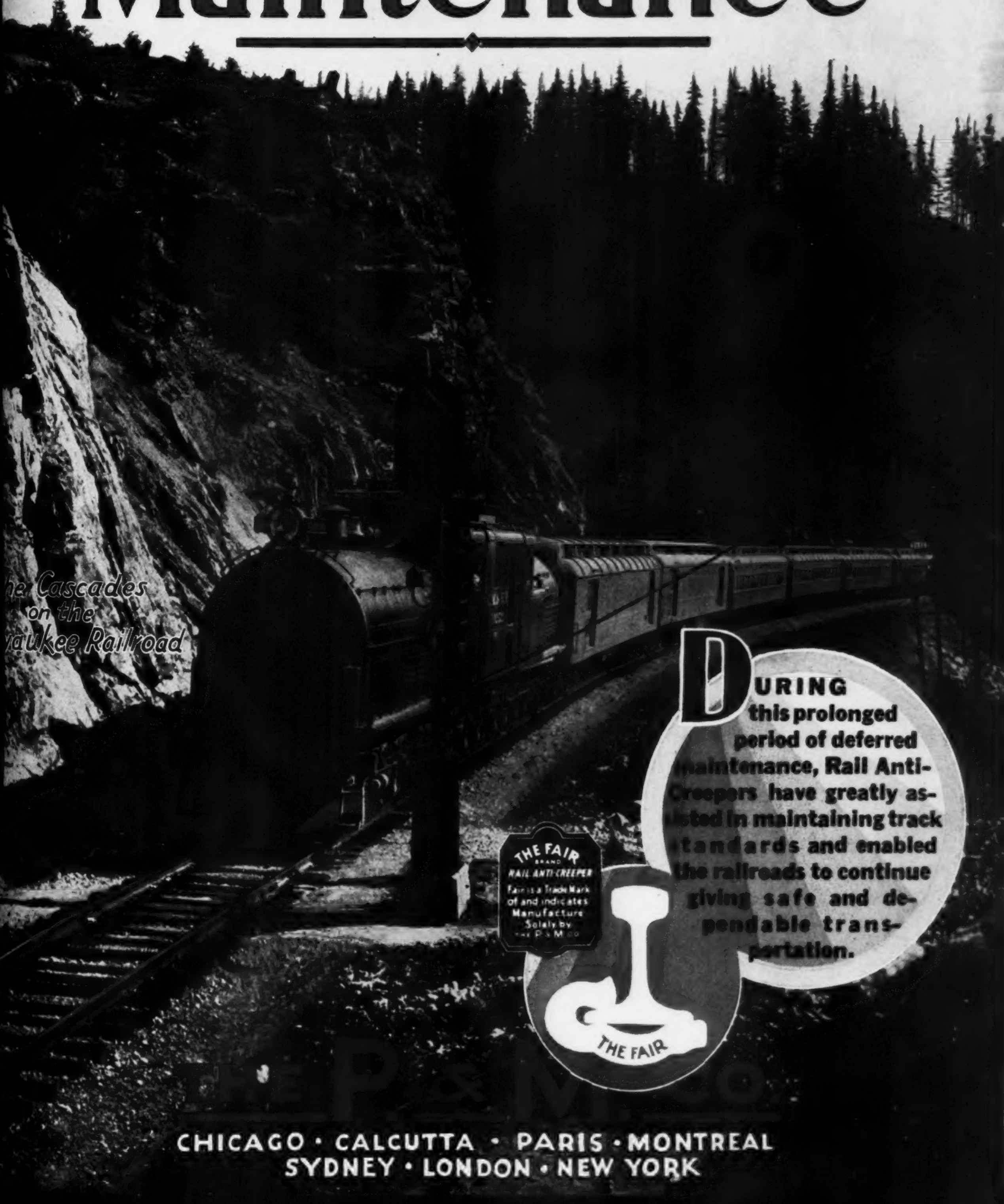
ROADMASTERS' CONVENTION NUMBER

Railway Engineering and Maintenance

October, 1935



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MANY years of experience with over 200,000,000 Lundie plates in service have demonstrated the economic advantages of the Lundie design.

With the Lundie Plate the resultant vertical and lateral load is at right angles to the multiple bearing area on the tie.

This important and exclusive feature prevents sliding at the base without the use of tie destroying projections.

No tie plate offers greater opportunities for immediate savings in first cost and future economies in maintenance than the Lundie Plate.

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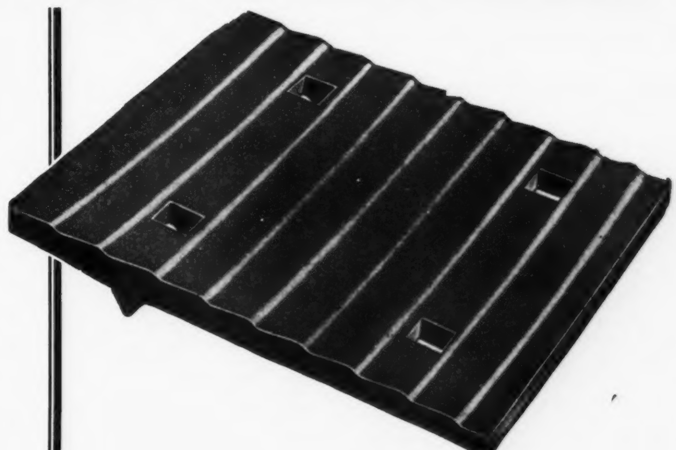

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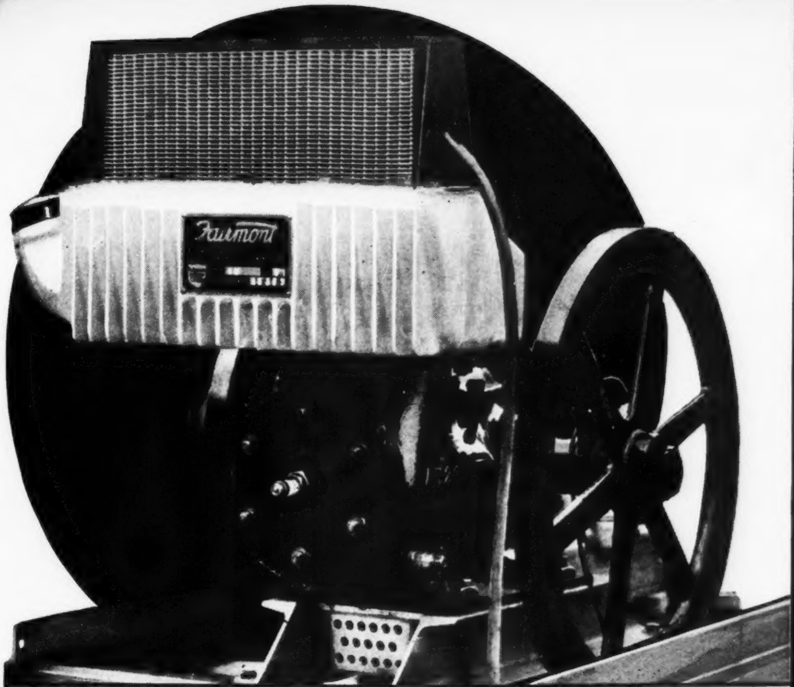
It protects ties against mechanical wear.
Has no tie destroying projections.
Does not cut a single tie fibre.
Plate seats itself perfectly.
It prevents the widening of track.
It gives proper inclination to rail.
Saves Ties—Rails—Maintenance.

LUNDIE TIE PLATE

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, $2.00; Canada, $2.50; Foreign $3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.



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When you railroad men who drive these Fairmont Cars describe them as "The Greatest Performers on Rails" you are paying high tribute to their power unit—to the famous Fairmont Model 0 Engine.

Whether you are driving one of the older cars or one of the smooth powerful new models, you know that every one of the thousands of cars built by Fairmont since 1909 has been powered by the genuine Fairmont horizontal, water cooled, reversible engine . . . that, while the engine in the new cars has many refinements, *it is fundamentally the same power unit* you have learned to depend upon through all these years.

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Performance ON THE JOB COUNTS

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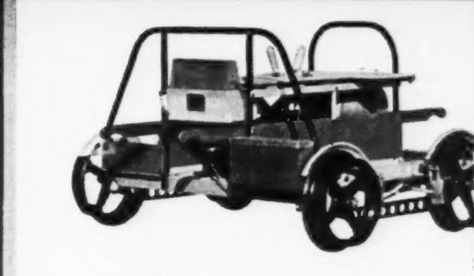
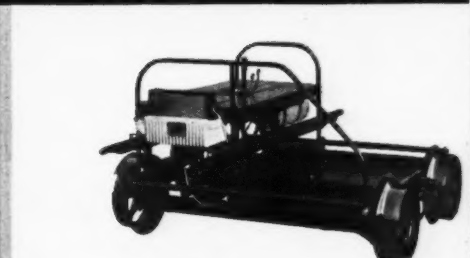
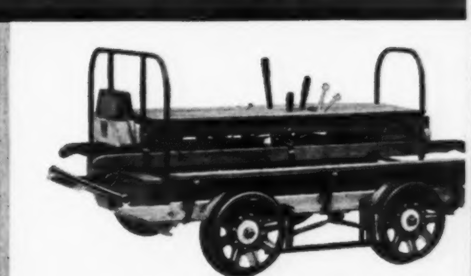


M9 (SERIES B)
ONE OR TWO-MAN INSPECTION CAR—ALUMINUM

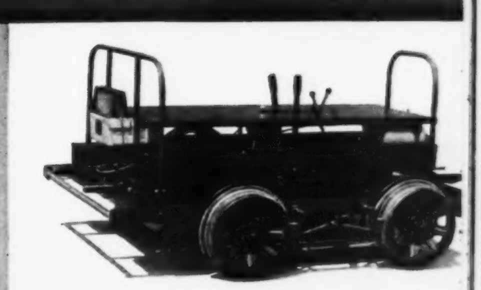
M19 (SERIES D)
ONE TO FOUR-MAN INSPECTION CAR—ALUMINUM



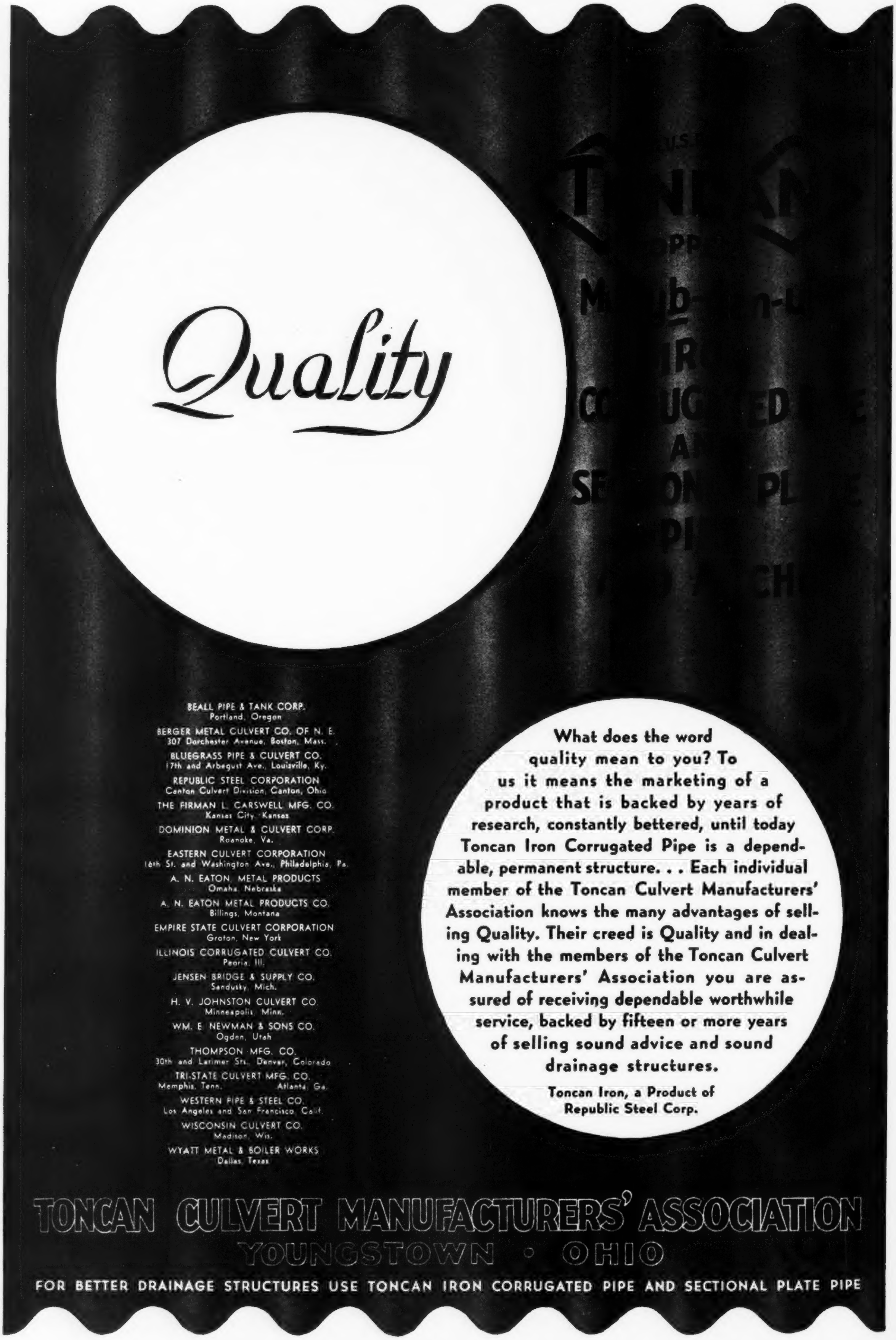
59 (SERIES B)
ONE OR TWO-MAN INSPECTION CAR



M14 (SERIES D)
LIGHT SECTION CAR—ALUMINUM



M14 (SERIES E)
LIGHT SECTION CAR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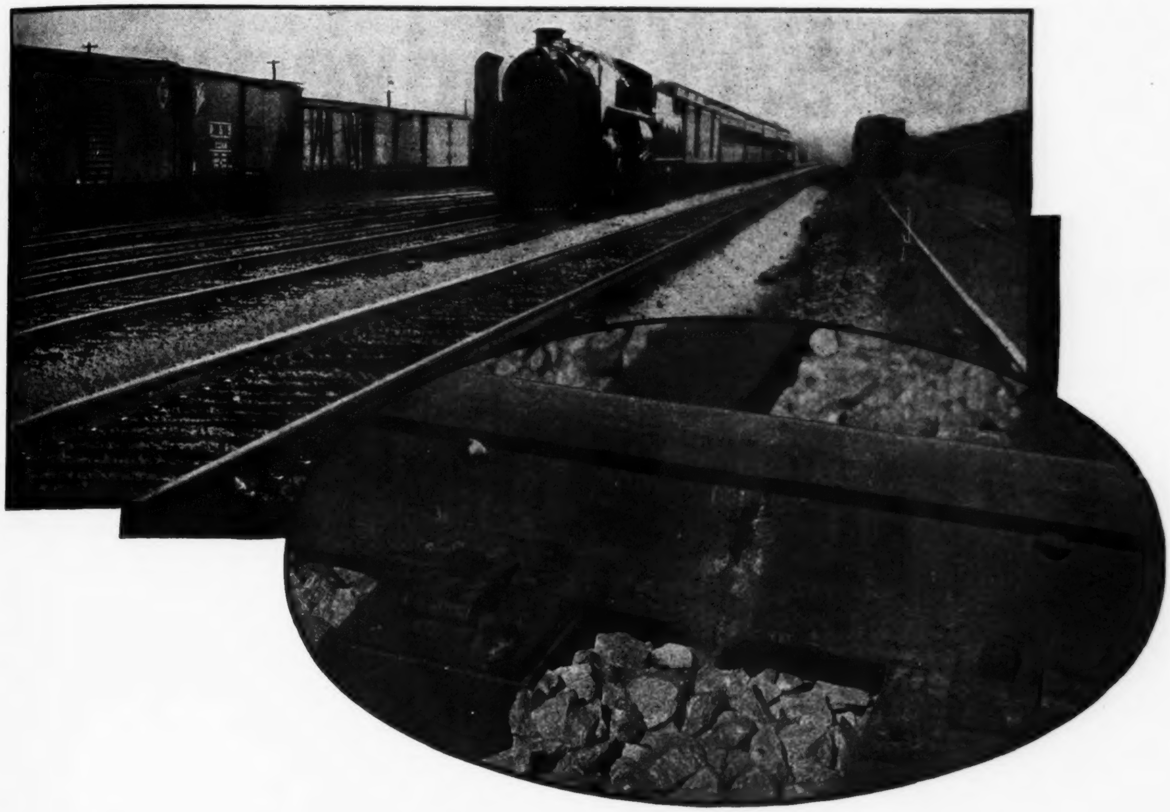

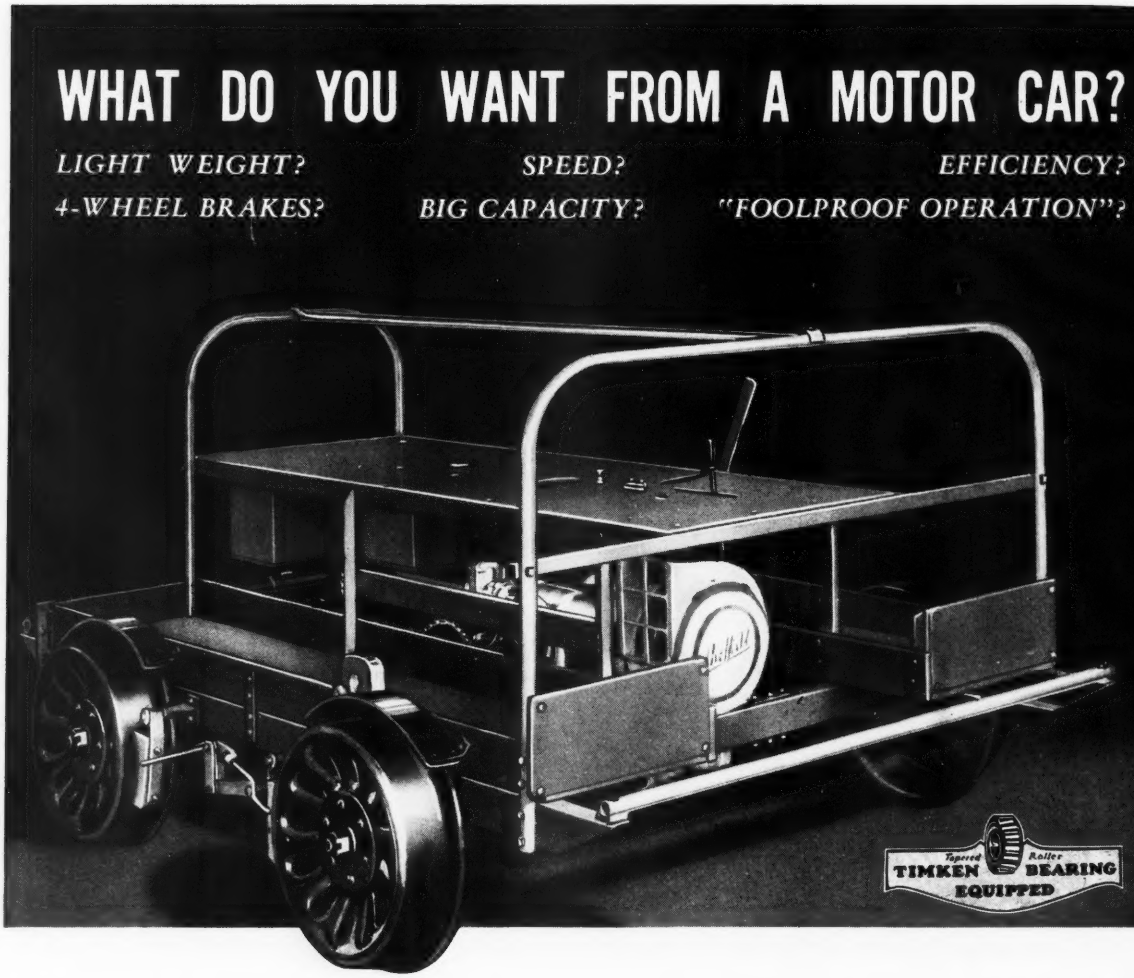

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WHATEVER you've wanted in a patrol or full crew section car . . . whatever you've hoped to find in a car built for year 'round service in every weather, you'll find in the F-M Sheffield "49."

Study these features! Light weight . . . sturdy construction . . . Sheffield air-cooled clutch and roller chain drive . . . 8 hp. forced draft, air-cooled engine . . . no water or radiator troubles to contend with . . . Timken crankshaft bearings . . . aluminum alloy pistons . . . ample tool trays to allow plenty of space for lining bars, track gauges, levels and other tools . . . heavy Timken bearing equipped axles . . . 4-wheel brakes . . . pressed steel channel type frame (aluminum optional) . . . malleable cast axle boxes . . . magneto equipped (battery optional) . . . trouble-free operation in every weather—in wet weeds, water, and in deep snow.

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See the Sheffield "48" and "49" on display in booths 41 and 42 at the Convention September 17-19.

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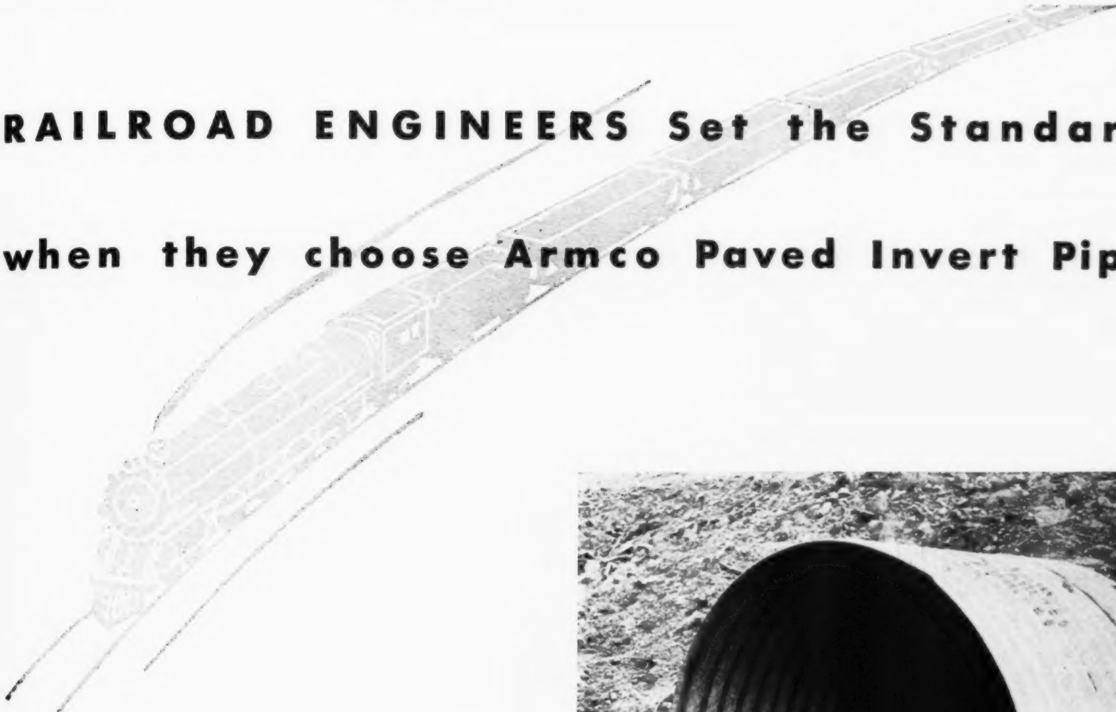

RAILROAD ENGINEERS are known to use reliably strong and durable, yet economical products. Hence other engineers respect their judgment.

Modern, high-speed trains with their faster schedules have naturally put a greater responsibility on the roadbed structures. At the same time, the reduced income of railroads has meant that strict economy must be practiced on all purchases.

So, it is especially significant that many leading railways have standardized on Armco Paved Invert Pipe for their small and medium size drainage structures. Experience has proved that this modern pipe meets the most critical demands for strength, durability and economy.

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Track Materials
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Lorain Heat-Treated Rails
Switch Stands
Tigerweld Rail Bonds
See NEXT PAGE FOR COMPANIES MANUFACTURING THE PRODUCTS SHOWN ABOVE

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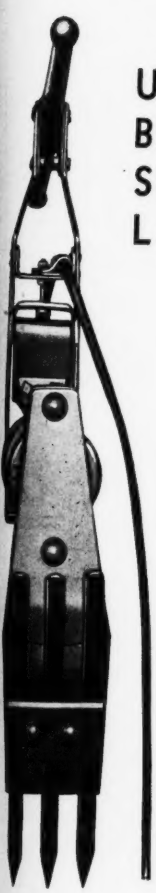
The
JACKSON UNIVERSAL TAMPER
in successful use as a
PICK TAMPER and BALLAST LOOSENER

FOR loosening and then tamping cemented or foul ballast . . . for spot tamping on low lifts due to the ability of the pick points to break through the old tight ballast and work under the ties . . . for loosening foul ballast between tie cribs and shoulders . . . for breaking up water pockets and correcting poor drainage . . . the JACKSON UNIVERSAL TIE TAMPER equipped with VIBRATORY PICK BLADE is fast, efficient and economical. Experience has definitely proved that these tools speed up the work of tie renewal gangs as much as four times over the old fashioned hand methods.

The JACKSON PICK TAMPER and BALLAST LOOSENER in typical ballast cleaning and tamping operations. 3600 powerful vibrations per minute, all concentrated on the pick blade without any vibrations reaching the operator. Simple, easily handled, trouble-free.



also
USED as an ADJUSTABLE BALLAST CLEANING, SKELETONIZING and LOOSENING PICK

FOR ballast cleaning operations where ballast must be penetrated to depths up to 12" or 14" the tool steel picks may be adjusted to varying depths of ballast and the points are easily renewed or redressed by any blacksmith. The high frequency vibratory action of these picks within the ballast is remarkably efficient and quickly separates coal dust, clay or dirt of any description from the ballast leaving it clean and usable. They are especially fast in the improvement of drainage along the ballast section and largely eliminate the removal of ballast from the crib.

ELECTRIC TAMPER and EQUIPMENT CO.
LUDINGTON, MICHIGAN

No. 82 of a series

Railway Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: IDEAS

September 26, 1935

Dear Reader:

Has it ever occurred to you that in these days of over-production and limitation of output in almost every line of activity, there is still one commodity for which there is yet a large unsatisfied demand? I refer to the need for ideas. Have you thought further that they are the merchandise of a magazine like Railway Engineering and Maintenance —that it is for ideas that you subscribe for our publication?

By this I do not mean to intimate that we originate all of the ideas published in our columns, although we hope that we contribute our share. However, our function is to bring to the attention of each of you meritorious ideas born of the minds and experiences of individuals and thereby make their benefits available to all.

Do you remember when maintenance men prided themselves on being "practical" and disdained the thought that they could learn anything about the upkeep of tracks and structures except through the slow and expensive school of personal experience? They depreciated ideas from other channels and made no effort to enlarge their sources of information. There still remain some who hold this thought, but it is my observation that they are rapidly disappearing. In their place I am finding a new group of alert, active men, eager to acquire ideas from every source. They care little where a method originates so long as it works.

It is from such men that the railway officers of tomorrow will come. It is among such men that Railway Engineering and Maintenance circulates. It is for them that our editors are constantly scanning the practices of railways everywhere that we may bring to you the ideas that are helping others. It is for such men also that progressive manufacturers present their sales stories through our advertising pages.

In these days of such exacting demands upon the railway industry and of such active competition for recognition and advancement between individuals within that industry, it is to the selfish interest of every individual to use all of the tools that will increase his personal knowledge and efficiency. Railway Engineering and Maintenance is such a tool.

Yours sincerely,

Elmer T. Howson

Editor

ETH:EW

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

October, 1935

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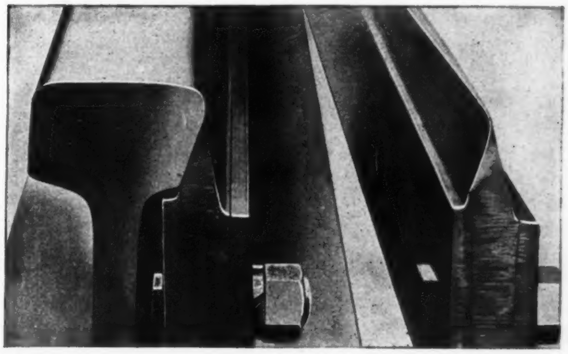
DESIGN 3028

ECONOMY—Over five times the life of common standard knife-blade switches, with less than 10% additional cost for machining stock rails. No recent innovation in trackwork will give a greater return on investment.

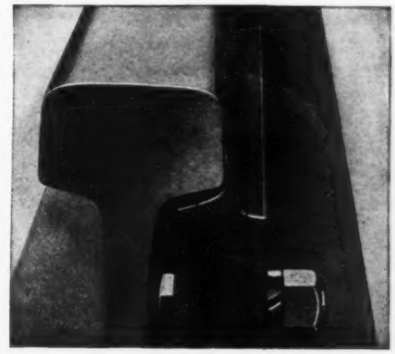
EASIER RIDING AND IMPROVED SAFETY—Omission of the usual chamfer cut on gage side makes the switch points easy riding. This is of special advantage on long curved switch points for high speed tracks. The "V" shape of the switch points will not break down, but wears smoothly and evenly. There is no occasion for use of switch point protectors.

EXTENT OF USE—Samson switches have been installed, with repeat orders, on most of the large railroad systems in the U.S.A.—proving the above claims.

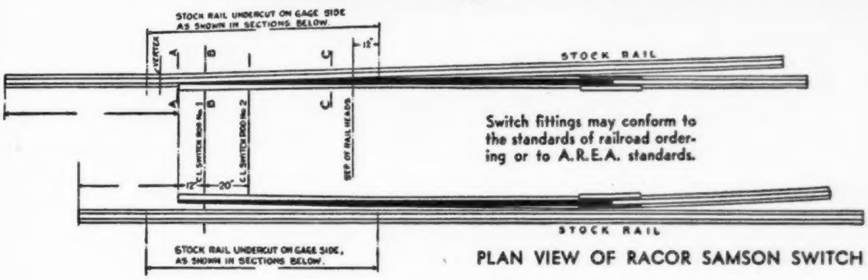
While the Samson switch is covered by United States and Canadian patents, all the larger manufacturers specializing in trackwork have license to furnish.



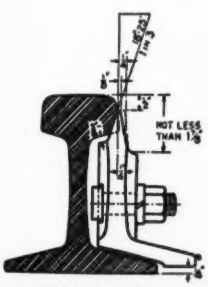
NEW
End View of Samson Switch Point



OLD
End View of common standard knife-blade switch point



PLAN VIEW OF RACOR SAMSON SWITCH



SECTION A-A

SECTION B-B

SECTION C-C

Samson points, on gage side, may be planed initially to desired point thickness without chamfer cut, or planed to A.R.E.A. standard detail No. 1000 as shown in sections.

The stock rail side reinforcing may be omitted or not carried to end of switch points, especially for rails having head width of less than 3 in.

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Railway Engineering and Maintenance

Buying Power

Railway Purchases of National Concern

In the five years ending with 1929, the railways of the United States purchased annually from manufacturers of this country, equipment, materials and supplies, other than coal, costing $1,400,000,000. Reduced to figures that can be appreciated more fully, the railways bought from the mills and workshops of the country $5,000,000 worth of their products every working day. This is a measure of the contribution that railway purchases make to the wealth of the country—a contribution that is equalled by no other industry except agriculture.

Equally striking is the change that has come about during the last five years. In contrast with average annual purchases of $1,400,000,000 in the period from 1925 to 1929, the railways bought only $320,000,000 worth of materials and supplies, other than coal, in each of the years 1932-1933, and their purchases this year are not running greatly above this low level. In other words, within three years the railways reduced the volume of their buying from the industries of this country by more than $1,000,000,000 a year, or approximately 3⅓ million dollars every working day. The magnitude of this *reduction* can be appreciated from the fact that the vast expenditures of the federal government for all emergency purposes, including AAA, FERA, CWA, CCC and PWA activities, up to July 1, 1934, did not greatly exceed the *reduction* in the purchases made by the railways during the last five years.

These comparisons afford a measure of the contribution which a prosperous system of railways makes to the industrial wealth of a nation. It illustrates likewise the importance to our national life of placing the railways in such a financial position that they will be able to make a contribution to business prosperity that is commensurate with their needs.

Many Channels

In considering the money spent by the railways, few persons appreciate the many channels into which this money goes. Railway purchases include not only rails, cars, locomotives, and other materials peculiar to railway operation, but also automobiles, typewriters, upholstery, gasoline and a myriad of other products common to all industry. The average large railway regularly carries in stock 50,000 or more different kinds, varieties and sizes of materials, while 20,000 more items are purchased for special purposes during a normal year.

Equally striking is the magnitude of the purchases of specific products. In normal years the railways take nearly 25 per cent of the entire output of finished steel. They consume 15 per cent of the lumber, ties and other forest products produced. They buy 25 per cent of the coal that is mined and also 12.5 per cent of the fuel oil. Purchases of this magnitude exert a most important influence on the degree of activity and the prosperity of these industries. This is evidenced by the fact that the accumulated decline in railway purchases of steel products from a single producer in three years of the depression approximated 11,900,000 tons. Likewise, the annual purchases of lumber and timber products have declined from 5,000,000,000 ft. b.m. in 1928 to 1,100,000,000 ft. b.m. last year, while the decrease in railway purchases of coal approximates 70,000,000 tons a year.

Distribution of Purchases

The average person fails also to appreciate the wide distribution of these purchases throughout the cities and towns of this country. Contrary to common impression, these purchases extend directly or indirectly into almost every community. When the Pennsylvania first applied to the Reconstruction Finance Corporation for a loan of $77,000,000 for the electrification of its line between Philadelphia, Pa., and Washington, D.C., it submitted a breakdown of the labor that would result from this project, which showed that employment aggregating 50,000,000 man-hours would be provided in 38 different cities, including areas as remote from this project as Minnesota, Arizona and Washington. Similarly, a recent order for 500 refrigerator cars required the builder to assemble materials from 46 different manufacturers. When the Union Pacific gave the Pullman Car & Manufacturing Corporation an order for its streamlined trains, this order not only created employment for 600 men at the shops at Pullman, Ill., but also provided work in factories in Detroit, Mich., in the textile mills of North Carolina, in mills at Alco, Tenn., in mines at Bauxite, Ark., etc.

This distribution of purchases is shown also by an analysis of orders placed in the routine of business by a number of roads. The Clinchfield, for illustration, is a road of less than 300 miles; yet within a single year it drew materials from 25 states. Likewise, the Louisiana & Arkansas, with 650 miles of light-traffic lines in the south, placed substantial orders with 111 companies in

19 states in a single year of curtailed buying. Similarly, the Chicago, Rock Island & Pacific placed orders in 1933 with 2,000 different companies located in 200 towns in 36 different states, while in that year the Southern Pacific bought more than $500 worth of materials from each of 1,400 companies located in 145 different cities in 33 states.

Summarizing these purchases for 26 roads operating 93,000 miles of lines, or two-fifths of the mileage of the United States, it is found that even in a year of greatly curtailed purchasing, 7,616 concerns located in 1,661 different communities received orders aggregating $500 or more. Broken down in another way, the purchases of this limited number of roads went to concerns located in 124 different towns in Illinois, 117 towns in Oklahoma, 92 towns in Missouri, 87 towns in Wisconsin, 82 towns in Iowa, 79 towns in Kansas, etc.

Referring to individual cities, the importance of railway purchases and the effects of the recent decline in purchases on these communities can be shown by comparisons of purchases made in 1933 with those for 1929. In Chicago, for illustration, the purchases of a single railroad decreased from $2,084,300 to $502,757. In Hammond, Ind., the purchases of this same road decreased from $137,750 to $31,272; in Shreveport, La., from $396,921 to $136,131, etc.

These figures illustrate the widespread interest that the public should take in the restoration of railway earnings in order that the railways may return to the markets of the country in a manner commensurate with their needs. This is a phase of the railway problem that warrants exploitation by every railway employee in order that the citizens at large may recognize their own personal interest in the prosperity of the railways and may be encouraged to foster those measures that may bring about the restoration of earnings to the level that is essential to railway buying that is adequate to supply the needs of both maintenance and operation.

Waterways

Do Not Neglect to Keep Them Clean

OWING to the limited rainfall since 1930, there is evidence that in some quarters the importance of keeping culverts and other waterways cleaned out, if not lost sight of, has been ignored. This attitude can be explained in part by the fact that during this period the section forces have been barely sufficient to care for the track and do such other work as required immediate attention. While the disadvantages of this neglect have been brought quite forcibly to the attention of maintenance officers in some sections of the country during the spring and summer of the present year, others have not suffered from the same unfortunate experiences.

Troubles resulting from wash or deposits of sediment seldom occur during periods of normal or subnormal flow, so that with minor exceptions the maintenance forces have ample time to correct conditions which will become acute if left until the stream is at flood stage, at which time little can be done in the way of prevention or correction. It has often been said that the best time to do winter work is in the summer and fall. This maxim can be applied with equal force to the emergency correction of drainage troubles in both winter and spring.

Obviously, in general, it is now too late in the season to start major drainage projects, but where streams have been neglected there is much that even the limited section forces now being employed can do to insure free waterways in both parallel ditches and those passing through culverts and other small openings. No one can foresee the weather longer than a day or two in advance. But records extending over many years show that there is seldom a wide departure over a long term from the average annual rainfall in any section of the country, although local departures may be very great. In other words, a period of deficient precipitation may be expected to be followed by one of an approximately equal excess. For this reason, any supervisor who longer neglects to keep the channels of his waterways open and in the best practicable condition to pass flood waters is likely to find sooner or later that he has been exercising poor judgment.

Supervision

May Be Cheapest Thing a Railway Pays For

ONE of the disquieting by-products of the depression has been the drastic curtailment in the supervisory organization of the bridge and building forces. On not a few roads, retrenchment has been carried to the point where the position of division supervisor of bridges and buildings, or master carpenter, has been abolished and his duties turned over to the already overloaded division engineer. In some cases also, this has been done in conjunction with a considerable increase in the mileage under the jurisdiction of the latter officer. As an emergency measure, such a step may be condoned, but even then its expediency is open to question. This is due in part to the importance of the proper maintenance of the structures, but more particularly to the highly specialized nature of the problems arising in their maintenance.

The railways have a large investment in these structures. The stability of many of them is essential to safe transportation. Others provide for the conduct of business. In either event, their stability is of prime importance. Even where safety is not involved, railway structures tend to deteriorate rapidly unless they are given constant attention, owing to the hard usage to which they are subjected, and damage to machinery may occur at any time. There are few roads, including those that are maintained to a high standard, upon which emergencies do not arise at the most unexpected and inconvenient times.

Because of the multiplicity of his duties, a division engineer, no matter how capable, is not in position to keep himself informed in detail, or know from personal inspection, as to the physical conditions and limitations of the structures under his jurisdiction, to the same extent that a supervisor can who specializes in this class of work. This may be a serious handicap to good

maintenance under the best of conditions. Where appropriations are restricted, the amount lost through depreciation by reason of failure to utilize the money available to the best advantage may be far greater than the apparent saving effected by abolishing the position of supervisor.

There is another feature that is sometimes overlooked when management is seeking for ways to reduce expenditures. Because of the highly specialized work done by the bridge and building forces, they need constant and detailed supervision. This is not only to insure high-grade work, but to prevent waste which is so likely to creep into the operations of this department unless a careful watch is maintained, for example, in the movement of gangs and the providing of material. One road has demonstrably saved a half million dollars a year by the simple expedient of eliminating these two forms of waste, although it had previously provided what was believed to be ample supervision.

Experience has shown that without this detailed supervision the bridge and building forces soon begin to show signs of demoralization, primarily because their work is not properly co-ordinated, thus opening the way for, if not actually creating, further waste. Obviously it is not possible for a division engineer with many other demands on his time to give close attention to the work of these forces. It seems worth while, therefore, to suggest that more thought be given to the possibility that proper supervision may save more money than lack of it, and thus be cheaper both now and in the long run.

Trends

Many Changes Warrant Attention

FEW industries are going through more far-reaching changes, even in this day of almost universal transformation, than the railways. Within the railway industry, no department is experiencing more rapid or revolutionary changes than maintenance of way. The evolution here is so rapid and is taking place in so many directions that few are aware of its scope; yet one must appreciate all that is taking place if he is to anticipate the future intelligently.

Consider the demands made upon the tracks and structures. Most striking is the marked increase in speeds that is evident in freight as well as passenger service. This is no passing fancy of the moment, for the public is demanding faster and still faster travel and will give its patronage to that agency which meets its desires.

Equally important in its effect on roadway maintenance is the trend towards the more intensive use of tracks. While the volume of traffic handled per mile of track has been reduced for the time being by the decreased activity in general business, the development of telephone dispatching, power operation of switches, centralized dispatching, etc., all reduce delays to trains and, combined with the operation of these trains at higher speeds, reduce the time of track occupancy for each train, with the result that the number of trains that can be handled over a given track is increased markedly. As a result, as traffic increases, second and other multiple main tracks will be taken up. All of this increases the wear and tear on the tracks that are retained in operation.

Closely akin to the increased utilization of existing tracks is the curtailment of construction and reconstruction activities, with their heavy demands on maintenance forces. In keeping with the transition in our national development during the last two decades, the railways have turned from extensive to intensive improvement of their properties, with corresponding changes in their inroads on the energies of maintenance forces. While one would be rash to contend that we will see little more multiple track construction, reduction of grades and rebuilding of classification yards, it is equally certain that changes in transportation methods will reduce the justification for such improvements for some years to come, at least.

In coping with the increased destruction of tracks and structures from traffic, and the conflicting demand of greater refinement in maintenance, much attention has been directed to the rapid adoption of machinery. Already mechanical equipment has supplanted manual methods in many tasks, while it is demonstrating its superiority in others. Still other operations await the inventor. It is to be expected, therefore, that the use of mechanical aids will continue to increase.

Equally striking changes are to be found in the materials used in the maintenance of tracks and structures. Take rail as an illustration. With heat treatment of the ends before they are placed in service to retard batter, with welding to overcome the batter that develops, with heavier sections to retard curve wear and kinking, it is evident that the life of rail is being extended to twice or three times that normally secured a decade or two ago. This, of course, reduces the amount of labor expended in renewal correspondingly. Even greater has been the reduction in labor expended in the renewal of ties as the rapid increase in treatment with preservatives has already doubled the life of ties and thereby eliminated some 60 million man hours of labor annually.

In other respects also, the trend is towards more permanent construction. More and better ballast, wider embankments and cuts, more adequate drainage, all contribute to a stronger track and lessen the day-to-day upkeep. In similar manner, better materials have been employed in structures, tending towards longer life. This trend is giving rise to a new approach to maintenance expenditures—that of determining the amount a road is warranted in spending in first cost to secure minimum expense for upkeep.

Still another trend is that towards specialization in gang activities. Roads have long laid rail and applied ballast with forces organized for those specific tasks. Of late, however, several roads have transferred the work of renewing ties to special gangs. Similarly, bolts are being tightened by small gangs, working out of face, with mechanical equipment. Going still further in taking work away from section gangs, a few roads have replaced them with floating gangs which move back and forth over a line at the specific direction of the roadmaster.

Practically all of these trends have one feature in common—that of reducing the amount of labor required in maintenance and of greatly improving the efficiency of that retained. These changes are fundamental in character. They are striking at the very foundation of time-honored maintenance of way practices. Their objectives and their results warrant the closest attention.

What About Your Foundations

DURING the last few years, the Central Region of the Canadian National has carried on an extensive program of underwater inspection of its bridges, during the course of which it has developed two unusually expert diving organizations and has devised and utilized a number of unique and unusually effective methods. Equipped with regulation diving equipment and complete auxiliary paraphernalia, including underwater telephones, for diving under the widest range of conditions, the substructures of more than 200 bridges, with underwater depths ranging from 5 to 60 ft. or more, have been carefully inspected during the last four years.

Some of the most interesting and unusual features of this work have to do with the methods used in making inspections in deep, swift water, and the extensive inspection diving that has been done by one of the divers, an expert swimmer, without any form of suit other than a pair of swimming trunks. The work of this man, which has speeded operations and saved hundreds of hours of inspection time and large diving costs, will be given consideration later in this article.

A Suit Diver About to Descend Beneath Several Feet of Ice

Large Program

With approximately 1,000 waterway structures on the more than 11,000 miles of lines on the Central region, including crossings of many important rivers, bridge maintenance has always been a major problem on the region. This has been due largely to the number and size of the structures, but also to a considerable extent to inadequate original design and construction of many of the bridges, especially as regards their substructures. To some extent also it has been due to the low temperatures, sudden thaws, floods, swift currents, ice flows and floating logs to which most of the structures are subject. At any rate, in 1928 the Central region started a program of thorough bridge inspection and repair which extended from top chords to the lowest points of substructure foundations. In this program, several million dollars have been spent in repainting and in both steel and masonry repairs.

While most of the superstructure work was completed by 1932, the substructure inspection and repair work has been continued. In this work, two diving crews have been employed, one of which has been used to a considerable extent in connection with heavy underwater repair and construction. Both crews are permanent organizations, with camp car outfits, and are thoroughly equipped for the most difficult and exacting classes of work.

Crews Fully Equipped

The equipment includes essentially official diving suits, pumps, diver's two-way telephones, and boats and rafts, but since the crews must be prepared to maintain themselves and their equipment, and to make all manner of emergency repairs, they are also equipped with a wide range of such devices, tools and supplies as carpenter's, tinsmith's and welder's outfits, oxygen and acetylene tanks, fuel, chain, cable and a variety of hoisting and mooring gear.

Central region of the Canadian National, in an extensive program of underwater inspection, has developed unusually effective equipment and methods. During the last four years, two crews have examined the substructures of more than 200 bridges, with underwater depths ranging from 5 to 60 ft. Many preliminary observations have been made by an expert swimmer without a diving suit, saving both time and expense.

In many cases the operations of the crews are supported by derricks, cranes, pile drivers, tugs, barges and scows, and involve the use of such special equipment as weighted shield cages to lower the diver in fast water, steel ladders and shot lines to facilitate the descent and ascent of the divers in deep water, and special steel-faced shields to deflect currents from the subscructures and thereby permit thorough inspection with comparative safety. In addition, each crew is prepared and equipped to do drafting work and to make comprehensive reports of conditions found.

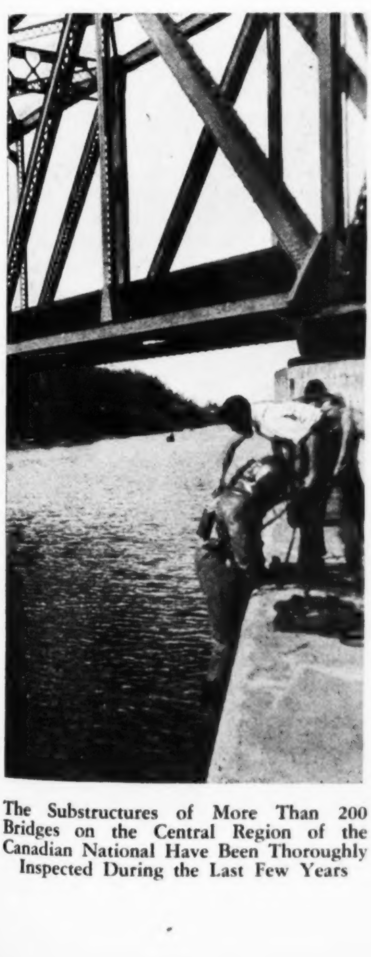
Each of the diving crews includes eight men and a foreman. One of the men in each crew is a licensed diver and usually does most of the diving work, while the other seven men are rated as diver's tenders. However, several of the men in each crew have had considerable experience in diving so that the work is never interrupted by the illness or absence of the regular diver. Furthermore, among the men with the rating of diver's tender are carpenters, welders and mechanics of considerable ability.

While numerous interesting conditions and experiences have been encountered by the diving crews, especially in connection with the inspection of substructures in the larger, deeper and swifter streams, including the Niagara, the St. Lawrence and the Ottawa rivers, some of the most interesting phases of their work have to do with the special equipment em-

ployed in carrying it out safely and effectively. For example, the diver's telephone system used is a unit of the equipment which has not only increased the safety of diving operations, but has, in itself, increased the speed of the work in some cases up to 50 per cent.

This equipment, which was designed specifically for the purpose, consists essentially of a telephone transmitter and a receiver mounted in the diver's helmet, another transmitter and another receiver for the use of the diver's attendant above the water, a portable telephone equipment box or case which houses a group of transformers and dry batteries required to supply current to the telephone transmitters, and a suitable length of waterproof telephone cable.

The helmet transmitter button is located in a recess at one side of the observation port, while the helmet receiver is mounted directly in the center of the top of the helmet with its diaphragm facing toward the shell and about 1/4 in. away. The equipment used by the diver's attendant consists of a breast-plate transmitter and a watch-case receiver equipped with a head band, so that the attendant can maintain constant communication with the diver while moving about



The Substructures of More Than 200 Bridges on the Central Region of the Canadian National Have Been Thoroughly Inspected During the Last Few Years

with his hands entirely free. The electrical connection between the equipment in the helmet and the power supply and auxiliary equipment in the equipment case is by means of a rubber-covered cable which, when in use, is usually coiled around the diver's air supply line to keep these two important lines together.

The principal advantages gained through the use of this equipment have been speed and accuracy in the inspection work, with largely increased safety. Through the use of the telephone, the diver makes constant report of his findings, relieving him of detailed memory work and the

One of the Divers, Dressed in Only Swimming Trunks and a Rubber Bathing Cap, Being Lowered in Front of a Pier on a Steel Ladder to Make a Preliminary Inspection of the Foundation

necessity of coming to the surface at short intervals to report. In cases of emergency, which have occurred in spite of the most careful precautions, the diver, co-ordinating his efforts with those of the above-water crew through the use of the telephone, has always extricated himself and been brought safely to the surface.

Diving in shallow still water has, in itself, presented no problems to the inspection crews. The most serious and hazardous problems have been

Winter Conditions Were Not Permitted to Interfere with the Canadian National's Program of Substructure Inspection

encountered in connection with the inspection of piers resting on piling or timber cribbing, or protected by piling, cribbing or rip rap, and especially where strong currents are involved. In these cases, which have not been infrequent, the diver is in constant danger of being caught and held by the pier protection-work, of having his suit torn or damaged by sharp projections or protruding spikes, or of having his air or safety lines become fouled. Furthermore, in currents of from 6 to 12 miles an hour, which prevail in many of the rivers where inspections have been made, the diver is in danger of being swept off his feet and placed at the mercy of the current and other dangers.

To avoid the special hazards to a diver in fast water, several methods have been employed successfully. In some cases, the diver has been lowered on a heavy steel ladder suspended from the fall line of a derrick. In other cases he has been let down on a shot line, which is essentially the fall line of the derrick boom weighted at its lower end by a 500-lb. shot or other suitable weight. This latter method has been used with large success in lowering and raising the diver practically vertically, and much more rapidly than would otherwise be possible, even in relatively swift water.

Where considerable current and depth have been encountered, the diver has been let down on occasions in a specially constructed rectangular

steel-frame, open-sided cage, with a sheet-metal wedge-shaped nose to deflect and break the force of the current. This cage, about 12 ft. long and 4 ft. wide, with a four-point hitch from a double hoist line, which helps materially in keeping the nose up stream in the current, lowers practically vertically in the water as the result of its weight. Moved along the face of the pier, always nose up stream, the diver inside, with comparative freedom and safety, has been enabled to make close inspection of all courses and joints.

A Suit Diver With Sheet Steel Cut-water

While the methods described have proved effective in many cases, there have been other cases where depths and currents have been so great as to require even greater protection for the diver. In especially swift water where the depth has not exceeded approximately 20 ft., wedge-shaped shields of old boiler plate, made on the ground, have been used effectively. These, with their wide flaring faces, have been lowered in front of piers, and, anchored securely in the bottom and braced at the top, have proved an effective break-water.

Where both swift currents and depths of from 20 to 50 ft. have been encountered, such as in both the Niagara and the St. Lawrence rivers, even the boiler plate shield has not proved suitable for protecting the diving operations. For making inspections under these conditions, an interlocking steel sheet piling shield has been used in conjunction with a special double-desk timber A-frame. In this arrangement, the wedge-shaped frame has been floated in front of and lashed to the piers, after which the sheet piling has been driven along the face.

Anchored in the bed of the river and supported at the top by the frame, this type of deflecting shield has proved effective under the most severe conditions. With a sufficiently wide flare to divert the current well beyond the sides of the piers, this type of shield has permitted the diver to encircle deep masonry substructures in fast running water with practically the same safety and freedom experienced in still shallow water. The difficulty at times with this type of shield, and difficulty has been encountered, has not been so much in connection with the diving operations as in constructing the shield itself, that is, in maneuvering the A-frame into proper position and in placing the piling.

An Example

A good example of the difficulty of this operation under certain conditions is afforded in a report of the underwater inspection of the masonry piers carrying the road's International bridge over the Niagara river between Black Rock, N. Y., and Fort Erie, Ontario. At this bridge the depth of water ranges up to 50 ft. and the current runs from 5 to 12 miles an hour. In addition, when the inspection of these piers was undertaken, traffic across the bridge was such as to preclude any possibility of operating from the deck of the structure with any degree of economy. Abstracts from the report made in connection with the inspection of the piers of this bridge follow:

"Accurate soundings in the deeper portions of the river were found to be impossible with an ordinary lead line. We had, therefore, to feel our way by soundings taken mainly after we were in position with our equipment. In the deeper portions of the river, a 60-ft. steel sheet pile was used in making soundings. The current at all of the piers being very strong, it was evident at the outset that it would be necessary in most cases either to create an area of comparatively quiet water at the various piers to give the diver protection, or to employ some other means of protection so that it would be possible for the diver to control his position in the water and make his examination.

"To effect quiet water about the piers, a double-frame of 8-in. by 10-in. timbers, braced in all directions so that it could be handled as a unit, was built, it being the plan to lodge this frame on the nose of the pier to support the upper ends of steel sheet piling, the bottom of the piling to be lodged in the river bottom. From what soundings we had at the time, it was believed that 30-ft. sheet piling would be of sufficient length to reach the rip rap which was supposed to be piled around the piers.

"The equipment first considered to handle the frame and the piling comprised a steam tug and a wooden scow 35 ft. long by 16 ft. wide, on which was to be erected a derrick with a 35-ft. boom. A start was made with this equipment and Pier 6 from the Canadian side was inspected successfully as a result of the protection provided by the piling. The outfit was then moved to Pier 5, where various attempts to reach bottom finally convinced us that we had approximately 50 ft. of very fast water to deal with. The small derrick being obviously inadequate for placing the longer sheeting required at this pier, a large steel scow was substituted for the smaller wooden one. This scow was 35 ft. by 90 ft. by 7 ft. 6 in., and was equipped with a full-revolving crane carrying a 65-ft. boom.

"The problem of a safe anchorage for a machine of this size in a 12-mile current in a position about 30 ft. above the nose of the pier, particularly where there was insufficient clearance between the bridge and the water to pass the scow if the anchorage dragged, gave us some concern. Eventually, however, we devised a combination anchor and bouy anchorage which proved effective.

"In the first place, we obtained two old American warship anchors, each of which weighed about two tons. These we cast separately about 600 ft. above the pier and about 300 ft. apart. A chain, approximately 125 ft. long, was attached to each anchor and was provided with a large bouy at the surface. The bouys, in turn, were connected by a 1¼-in. steel cable bridle, from which a 1¼-in. steel cable was played out from the scow until the scow reached a point approximately 200 ft. above the pier. Here we attached another bouy, to which, in turn, we attached a 24-in.

A Typical Crossing on the C.N.R.

steel single pulley block. This was as close to the pier as it was considered safe for the tug to approach with the scow in tow. At this point we passed the moving cable of the scow deck winch around the pulley and then released the tug and lowered the scow until it was in position directly above the nose of the pier.

"After completing this operation successfully, the tug again took the scow in tow and moved it over to the rest pier, where our material was stored. Here we took on a load of steel sheeting and picked up the timber frame with the deck crane. Carrying the frame suspended from the boom and lashed to the stern of the scow, we then steamed out to our anchorage. After the scow had been secured to the anchorage, the tug was released, and we lowered the scow to a point near the pier and guyed the timber frame in position on the pier nose. We then began placing steel sheeting.

"It being impossible to calculate exactly the pressure that would be developed on the sheeting by the action of the current, we proceeded cautiously for fear the pressure might crack the frame. In spite of this caution, the lower forward timber of the frame broke. When we had about 15 sheets of 55-ft. straight-web piling in place, the water pressure bent them inward sufficient to throw an abormal strain on the bottom timber. As a result, this timber cracked. We withdrew six of the sheet piles immediately to relieve the strain.

"In repairing the frame, two short cable slings were made and were passed under the bottom timber and then up over a new timber which we placed in position at the surface of the water. The running ends of the slings were then drawn tight by the hoist, which pulled the new timber down into line, with the damaged one below it. In this position, the new timber provided the necessary reinforcing for the old timber. Extra struts were then placed and the work of placing the piling proceeded as planned originally, except that arched-rib piling was substituted for the straight-web piling. This type withstood the water pressure without appreciable bending.

"When approximately 50 sheets of the piling had been placed, the main current was deflected some 20 ft. from the sides of the pier. We then laid a platform on the upper surface of the frame, assembled the diving gear, and began making our inspection. The diver descended the first 20 ft. on a steel ladder, but was lowered the balance of the distance to the bottom on a shot line, that is, a line having a heavy weight attached to its lower end and allowed to rest on the river bottom, while the upper end was lashed to the frame. Only about two minutes was required to lower the diver to the bottom.

"The inspection of Pier 4 was largely a repetition of the methods and the problems encountered in inspecting Pier 5. The inspection of Piers 1, 2, 3 and 8 was completed without the erection of the sheet piling shield.

The A-Frame Breakwater Brace as Used When Inspecting the Piers of the International Bridge, Before the Steel Sheet Piling Was Driven Along Its Face

"The remaining pier inspected was the pivot pier, known as No. 7. This pier is octagonal in shape, and only its east and west sides are exposed, since the north and south sides are protected by the rest pier. The current along both the east and west sides is very fast, however. In effecting the inspection of this pier, a steel-frame cage with its own shield, in which the diver stood, was lowered to the bottom of the river. This cage arrangement proved highly successful. The inspection of this pier was completed in half a day, as against a week's time which would have been required if other less rapid methods had been employed."

Swimmer Makes Inspection

While most of the underwater inspection work on the region has been carried out by divers equipped with regulation diving suits, a large part of it, in water up to about 25 ft. in depth, has been carried out by a man without any dress other than a pair of swimming trunks. This man, who was high tower diving champion of Canada from 1927 to 1929, is a regular member of the maintenance department diving crew, and is now a licensed suit diver.

It was evident that, unencumbered by a regulation diving suit, this man could do much of the general inspection diving, especially for preliminary inspections, with a large saving in time and expense. Frequently, with only a bridge foreman or an inspector, he has gone to outlying bridges, and, with no preparation or special equipment, has examined the underwater portions of their piers.

Operating with the regular diving crews, he has also made preliminary inspections of numerous piers. In many cases he has brought up reports of conditions which have made further detailed inspection unnecessary, while in other cases his reports have shown the necessity for thorough inspection by a suit diver, and in some cases, the necessity for prompt repairs. Typical of this class of work is that done at one bridge with seven piers in water from 7 to 20 ft. deep. Here, all seven piers were inspected and a complete report was made of conditions in three hour's time. It is said that this work, if done by a diver in a regulation diving suit, would have required six or seven men with boats, rafts, pumps and all of the other equipment necessary for suit-diving operations, for 10 days to two weeks.

Operating with the construction diving crew, this diver, working without a suit, has also saved time and expense in diving operations. One of his most frequent operations in this connection has been in conjunction with underwater clamshell excavation work. Here, when obstructions have been encountered, or when it has been desired to ascertain the condition of the bottom of the excavation, he has surface-dived into the water and returned with his report in a few moment's time. In many cases he has accomplished in a few minutes what would have taken a suit diver and several men two or three hours, saving not only the expense in this regard, but also preventing delay to the excavating operations.

These unsuited diving operations are not regarded by the diver as especially hazardous. This is primarily because of his confidence in his ability as a swimmer. The greatest hazard to his work has been underwater obstructions about piers, such as piles, logs and timber cribbing which may expose spikes and sharp jagged projections. Thus far he has avoided all of these hazards, having made examinations of more than a hundred piers without sustaining any injury.

The secret of the safety with which this diving has been done is found in the fact that the diver never takes chances or overtaxes his energy. Thus, he never dives from above the surface, because of possible obstructions

(Continued on page 577)

Eight articles have been published in which the rules for the construction and maintenance of roofing have been given as they appear in the manual issued by the Northern Pacific for the guidance of the building forces on that road. This, the ninth and last article of the series, describes the method for applying and maintaining roofing constructed of rag felt and asphalt without gravel or slag surfacing.

Roofs—

Laying Smooth-Top Rag Felt and Asphalt Roofing

RAG-FELT and asphalt roofs, as they are applied on the Northern Pacific, are three-ply construction with smooth top, i.e., without the addition of a mineral surface of either gravel or slag. The specifications for the materials required for this construction, except the felt, are the same as those covering the asbestos-felt and asphalt roofing which were given in the preceding article of this series. For this reason they will not be repeated, but only the requirements for the felt will be given, since the other materials, including the flashing, are the same. These requirements follow:

All materials shall be of the best grades and of approved brands. Every container and every roll of felt shall bear the manufacturer's brand and label.

Base felt shall be asphalt-saturated rag felt and shall weigh not less than 30 lb. per 108 sq. ft.

Finishing felt shall be asphalt-saturated rag felt and shall weigh not less than 15 lb. per 108 sq. ft.

Rules for Making the Application

In the construction of rag-felt and asphalt roofing over a wood deck, there shall be used one thickness of 30-lb. base felt, two thicknesses of 15-lb. finishing felt and for each 100 sq. ft. of completed roof not less than 90 lb. of asphalt for mopping between the felts and for the surface finish.

In making the application, lay one thickness of 30-lb. felt over the entire roof deck, lapping all sheets two inches. Extend the felt two inches up, but do not cement it to all vertical surfaces to be flashed. Seal the laps with hot asphalt and nail on six-inch centers. In addition, nail in two parallel rows approximately 12 in. apart and 12 in. from the laps, spacing the nails on 18-in. centers staggered.

At the eaves, apply galvanized sheet metal edging strips, made in accordance with the details shown in the drawing, and nail to the roof on four-inch centers about one inch from the inner edge. Nail the edging strips to the fascia, spacing the nails on six-inch centers about one inch from the lower edge. The edging shall be applied over the base felt and before the finishing felts are laid. The metal shall then be primed with asphalt primer and allowed to dry before it is placed or before the mopping for the finishing felts is applied. The finishing felts shall be laid over the top of the edging and flush with the eaves and mopped solidly to the edging with hot asphalt.

At the gable overhang, apply the edging strip after all felts have been laid. In other respects this application shall be the same as at the eaves. Cover the exposed edge of the metal on the roof with a strip of 15-lb. felt 4 in. wide, embedded in and mopped over with asphalt.

Over the entire surface of the base felt apply a mopping of asphalt into which, while hot, embed two thicknesses of 15-lb. finishing felt, each sheet over-lapping the previous sheet by 19 in., leaving 17 in. exposed—when using 36 in. sheets. Extend the sheets 2 in. up, but do not cement them to all vertical surfaces to be flashed.

In addition to the covering thus provided, apply on all ridges one thickness of 15-lb. felt of full width, embedding it in asphalt and mopping it to the roof surface.

After the flashing is completed, finish the entire roof surface with a mopping of approximately 30-lb. of asphalt per 100 sq. ft.

The provisions for flashing, including both materials and workmanship, are the same as those for asbestos-felt and asphalt roofing, for which reason they are not repeated here.

Maintenance

In general, the maintenance requirements for this type of roof are substantially the same as for roofing constructed of asbestos-felt and asphalt. It will be noted from the foregoing, however, that instead of the liquid asphalt surface coating, which is provided for the asbestos-felt type of construction, the rag-felt roofing is mopped with hot asphalt for the finishing surface. For this reason a special word of caution is included in the rules for maintenance, as a finishing surface of this kind is

likely to require more attention than where the liquid coating is used. The rules for maintenance are given in full.

With a properly constructed asphalt and rag-felt roof, there should be practically no maintenance requirements for several years, except those resulting from external damage.

If leaks do develop however, the weak points should be reinforced by mopping on two additional thicknesses of finishing felt, the top layer to overlap the bottom layer four inches around all edges. A top coating of hot asphalt should be applied to the patch and allowed to extend several inches out on the roof surface.

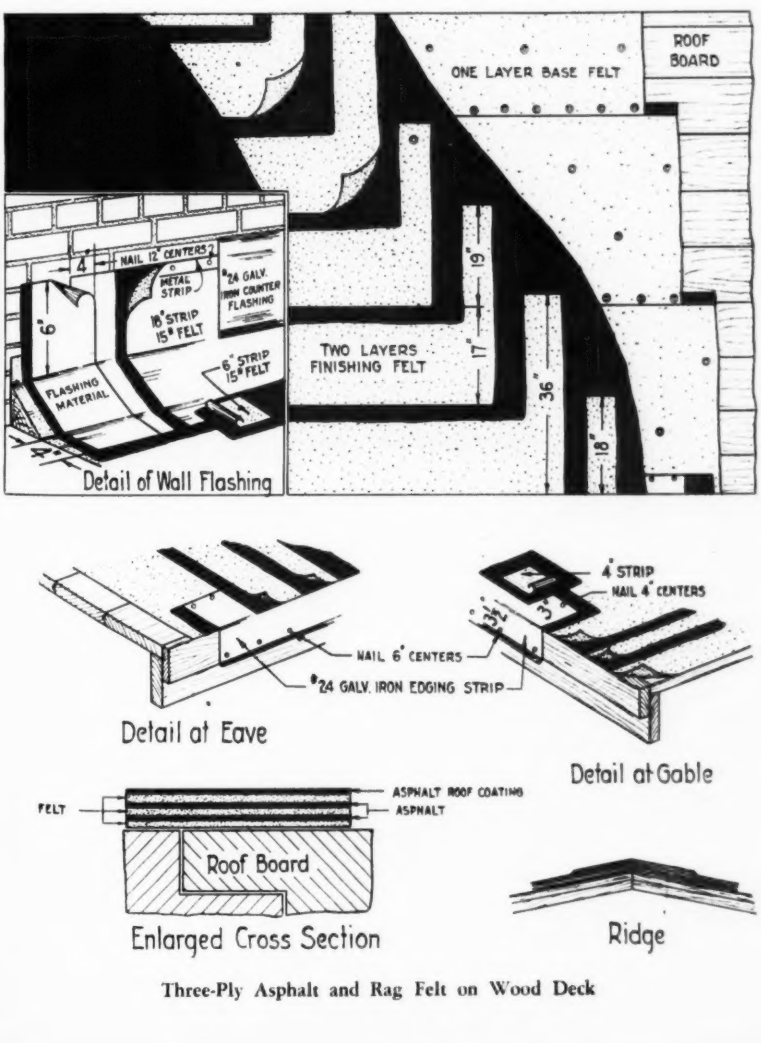
Periodic inspections should be made and any trouble detected should be corrected before it becomes serious.

Joints in the flashing should be watched carefully and any that show signs of loosening should be re-cemented or reinforced as they seem more desirable. Laps on the roof surface that show signs of loosening should be treated in the same manner.

Asphalt and asphalt-saturated felt, when exposed to the elements without the protection of a mineral surface, lose the light oils and in the course of a few years dry out and becomes brittle. For this reason, the surface of a roof of this kind should be given period dressings of hot asphalt as the necessity for this develops. Such coatings should be applied only after the surface has been thoroughly broomed off and should not exceed 25 to 30 lb. per 100 sq. ft. When asphalt is applied in thicker coatings and is not protected by mineral surfacing it will almost invariably "alligator" and go to pieces much more rapidly than if applied in thin uniform layers.

A roof constructed of rag felt and asphalt, if given reasonable attention should be good for many years of satisfactory service. If neglected, it is quite likely to be unsatisfactory sooner than is expected.

Plastic roofing cement can be used to advantage in making maintenance repairs. It is particularly useful in connection with the construction of flashing, around skylights, etc.



Three-Ply Asphalt and Rag Felt on Wood Deck

Foundations

(Continued from page 575)

beneath the surface. In most cases, always up stream from the structure, he surface dives after being taken out into position on a boat or raft, and swims down to the bottom. In deep water he has used a shot-line to be lowered to the bottom, and on certain occasions he has descended on a steel ladder or a steel pole. These means of facilitating his reaching the bottom have been found particularly effective where considerable current has been encountered.

All of the diving and inspection work of the diver is done with his eyes open, although at considerable depths, because of the darkness, he relies largely upon his sense of feeling to ascertain conditions. At the bottom, he feels about the bases of the structures, completely encircling them, and then follows them upward, examining course by course and joint by joint as he ascends. Each examination is, of course, a succession of dives, 30 or more being required in the case of some of the larger structures.

The length of time the diver stays under on each dive when not using a diving suit varies from about one to two minutes, depending upon conditions. In relatively shallow water, where little time is lost in making repeated dives, he limits the length of time under water, but at deep piers, where considerable energy and time are lost in descending repeatedly, he usually stays down as long as two minutes. The only tool that he takes to the bottom with him is a short steel bar, and this he takes only after he has in previous dives discovered some situation which requires more thorough probing.

The routine diving work on the Central region has been confined largely to the spring, summer and fall months, but on many occasions underwater inspections have been made in the middle of the winter, beneath several feet of ice. In the winter work the suit diver has always been employed, but the inspection work by the diver without a suit has begun as early as April and has continued as late as November 1.

All of the underwater inspection work on the Central region has been carried out under the direction of T. T. Irving, chief engineer, and C. P. Disney, bridge engineer. The actual diving in the Maintenance inspection work has been in direct charge of W. Johnson, general foreman, and the man who has done the diving without a suit, as well as a large amount of diving with a regulation suit, is Walker H. Kayes.

First Report on Fissured Rails

FAILURES of rails from internal fissures of any kind is essentially a progressive fracture of the type called fatigue failure. These fissures usually originate at shatter cracks that form in the rails during manufacture as a result of internal stresses that develop during the cooling of the rails after they have left the rolls. All rails do not develop shatter cracks while cooling on the hot bed and not all shatter-cracked rails develop fissures. Shatter cracks in rails are not uniformly distributed among all rails of a heat. In other words, they are found in some rails and not in others. Likewise, there is the same lack of uniformity with respect to the distribution of shatter cracks along the length of a given rail.

Internal fissures have been developed in the laboratory in rails containing shatter cracks under conditions approximating those to which the rails are subjected in actual service, by applying a load as low as 40,000 lb. Field tests involving observation on 90,000 car wheels in regular train operation indicate that actual load effects of 40,000 lb. or more may occur as frequently as 1 wheel in 1,000.

Rails Specially Treated

Tests were made on rails that had been given special thermal treatment, either before or during the cooling period. These rails showed an almost complete absence of shatter cracks and none of them developed an internal fissure under more than 1,000,000 repetitions of a rolling-wheel load of 75,000 lb.

Internal fissures in rails grow as a result of stresses produced by the combined effects of bending and wheel pressure in service and the latter is by far the more important factor. In laboratory tests of rails in a rolling load machine, fissures have been developed under the wheel load at sections where the bending moment was very small but never, even in shatter-cracked rails, at sections of heavy bending moment outside of the path of the wheel load. For this reason, it seems apparent that the stress under the wheel load on the rail is the factor of prime importance in the development and growth of fissures.

Stresses set up in rails, which result in the development of internal fissures, are practically independent of the size of the rail. The results of rolling-load tests show that the start of a destructive fissure seems to be due to the direct action of the wheel load rather than the bending stress. For this reason, it seems that the starting of fissures will not be hindered by the use of heavier rails, except so far as they may make track conditions smoother and reduce the "dynamic augment" of wheel loads. They cannot be expected to reduce the wheel loads due to flat spots on the wheels. Heavy bending moments tend to cause transverse fissures, while heavy wheel loads and low bending movements tend to cause horizontal fissures.

These facts are set forth in a progress report by Professor H. F. Moore, in charge of the test party of the Joint Rail Investigation of Fissures in Railroad Rails, which has just been issued in Bulletin 376 of the American Railway Engineering Association. This report comprises the first published record of the results of four years of intensive research in this field, which was initiated by the railroads and manufacturers of rails, who agreed to share equally in an expenditure of $250,000 for this purpose over a period of five years.

Tie Renewals Increase in 1934

A MARKED increase occurred in the total number of ties renewed by the railways of the United States in 1934, as compared with 1933, according to the annual tabulation of crosstie renewals, which the Committee on Ties of the American Railway Engineering Association prepares from statistics furnished the Interstate Commerce Commission.

A scrutiny of this tabulation discloses that 104 roads inserted more ties in 1934 than in 1933, while on 39 the renewals were less and on one road the replacements were the same in both years. This compares with a similar increase on 75 roads in 1933 and a similar decrease on 71 roads, as compared with 1932. This is also confirmed by a tabulation just issued by the Bureau of Railway Economics of the Association of American Railroads which shows that the tie renewals on the Class I roads aggregated 43,306,205 in 1934, as compared with 37,295,716 in 1933.

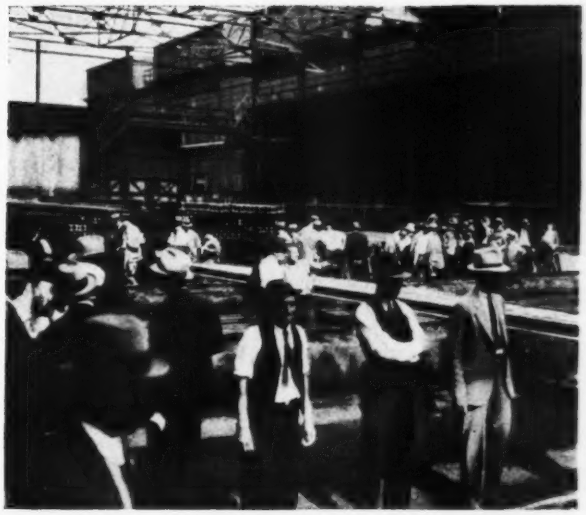
By Railroads

In the order of renewals per mile of track, those roads having the largest number of replacements were the St. Louis, San Francisco & Texas, 427; the Norfolk Southern, 386; the Duluth, Winnipeg & Pacific, 375; and the Northern Alabama, 364. Illustrating the disparity between those roads having a high percentage of untreated ties in service and those that have been using treated ties over a period of years, the Lehigh & Hudson inserted only 23 ties per track mile in 1934, 22 in 1933, and had a five-year average of 44. The Central of New Jersey came next with 33 for 1934, 45 in 1933 and had a five-year average of 63. The Reading stood third with 35 ties in 1934, 29 in 1933 and a five-year average of 67. While the renewals per mile for 1934 on the Pittsburgh & Lake Erie totaled 41 in 1934, and 35 in 1933. This road had the lowest five-year average, 29, which is accounted for by the fact that the tie renewals for the years 1931 and 1932 were only 4 and 5 per mile, respectively.

While the relative proportion of treated and untreated ties has remained practically unchanged for the railways as a whole, there have been marked changes so far as individual roads are concerned. As an illustration, in 1932 the untreated ties inserted by the Baltimore & Ohio were only 1.1 per cent of the total ties used. This increased to 53.3 per cent in 1933, but in 1934 untreated material represented only 4.2 per cent of the total. A similar example is the Central of Georgia, which dropped from 18.3 per cent of ties untreated in 1933 to 3 per cent in 1934; the Chicago, St. Paul, Minneapolis & Omaha, from 52.3 per cent to 24.7 per cent; the Great Northern, from 17.1 per cent to 8.1 per cent; and the Northern Pacific from 23.4 per cent to 6.3 per cent, in each case the comparison being between 1933 and 1934.

On the other hand a number of roads increased the use of untreated ties in 1934, as compared with 1933. Among these were the Delaware, Lackawanna & Western, from 5.7 per cent to 15.6 per cent; the Grand Trunk Western, from 29.4 per cent to 42.4 per cent; the Atlantic Coast Line from 73.7 per cent to 96 per cent; and the Chicago, Milwaukee, St. Paul & Pacific, from 13.6 per cent to 31.4 per cent.

The Roadmasters and Maintenance of Way Association has held conventions every year, beginning with 1883, except in 1931, 32 and 33, when its meetings were abandoned at the request of the railway executives. Since its recent convention was therefore the fiftieth, a special evening session was devoted to addresses on subjects of historical interest to the members.



The Roadmasters' Party at the Inland Steel Company's Mill

Roadmasters

Hold Golden Anniversary Meeting

ON SEPTEMBER 17, 18 and 19, the Roadmasters and Maintenance of Way Association held what its executive committee designated as the Golden Anniversary meeting, as a fitting recognition of the fact that this was the fiftieth convention since the association was organized. Based on the attendance, measured by the registration of 250 railway maintenance officers, and the character of the program, which included 5 committee reports and 11 papers and addresses, as well as the business-like conduct of the sessions and the active interest shown by those present, the convention was in every way a credit to the pioneer roadmasters who had had the enterprise to bring the association into being. The convention was held at the Hotel Stevens, Chicago, and as in past years, the Track Supply Association presented a display of track materials and appliances in the exhibit hall adjoining the convention hall.

Addresses of Welcome

The evening of Tuesday, September 18 was set aside for an historical review of the association's activities and of the advance in track construction and maintenance during the last 50 years, in which development the association has played no small part. The story of the organization and growth of the association was presented by George E. Boyd, associate editor of *Railway Engineering and Maintenance;* while B. E. Haley, general roadmaster of the Atlantic Coast Line, Lakeland, Fla., gave a lucid picture of track maintenance as it was carried on during the early days of the association's career. In a similar vein R. L. Cairncross, district sales manager, National Lock Washer Co., Chicago, drew on his long experience in both railway service and in the railway supply industry.

Approximately 400 members and their friends attended the annual dinner of the Roadmasters' Association and the Track Supply Association on Wednesday evening. Following the close of the convention on Thursday noon the convention party was conducted on a tour of inspection through the rail mill of the Inland Steel Company at Indiana Harbor.

Evening Session

Shortly after calling the convention to order, President Charles W. Baldridge, assistant engineer (A.T. & S.F.), introduced Harry G. Taylor, chairman of the Western Association of Railway Executives, who, in welcoming the members to Chicago, referred to the apparent conspiracy of nature against the railroads, as evidenced by the dust storms of the Southwest, which were followed almost immediately by floods of disastrous magnitude which added greatly to the problems imposed on the roadmasters by the depression. He paid his respects to the officers of track maintenance for the success that they had attained in maintaining their tracks in such an excellent state of maintenance with the limited funds at their disposal, and for their display of practical knowledge, courage and loyalty in these trying days. It is particularly significant, he said, that the tracks have been found capable of handling trains at higher speeds than ever before.

Mr. Taylor also called attention to certain recent notes of encouragement, including the enthusiastic response accorded the western railroads by the public during their celebration of Railroad Week early in the summer. He attributed this to public admiration of the fighting spirit which the railroads have shown in adversity. Mr. Taylor closed his address with an eloquent tribute to the constitution of the United States and to those who founded it.

Greetings from the American Railway Engineering Asociation were tendered by its president, R. H. Ford, (assistant chief engineer, C.R.I. & P., Chicago), who traced the history of associations of railroad men engaged in the maintenance and construction of railway tracks, bridges and other structures, showing how the early gatherings of the roadmasters and bridge supervisors were followed by the organization of the A.R.E.A., and how these and other organizations are now being gathered into a unified, co-

ordinated activity through the agency of the Association of American Railroads. The opportunities for co-operative effort among men engaged in similar pursuits on the railroads are greater than ever before and through the agency of a well organized procedure the benefits to be gained are definitely assured. The Roadmasters Association, he said, is now afforded a well-defined place in a plan that will provide a scientific attack on the problems that confront the railroads, in which the work of the laboratory will be co-ordinated with the mature judgment and experience of the men engaged in practical problems of the day.

T. H. Strate, (division engineer, C.M. St. P. & P.), first vice-president of the American Railway Bridge and Building Association, presented greetings from that organization, pointing out that the two associations are more closely allied in aims and duties than any other two associations of railroad men. He paid tribute to the roadmasters, with whom he had intimate contacts during the course of his railway experience, for their enviable record for service and loyalty.

President's Address

Following a review of the association's activities during the year, during which he paid tribute to three past presidents who had died during the year, A. M. Clough, (N.Y.C.), James Sweeney, (C.&E.I.), and P. J. McAndrews, (C.&N.W.), President Baldridge addressed his remarks to the subject of industrial depressions, and the lessons they teach, this portion of his presidential address being reproduced below:

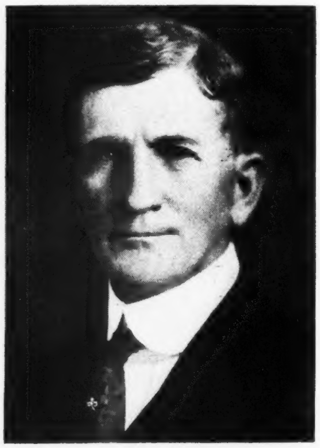
The depression which has held us in its grip for five years has caused many to think that further effort toward the raising of standards and improvement in methods is useless, but such is not the case, the need for improvements is steadily increasing. There is an old adage which states that "the history of the past points the road for the future" and since this is not the first depression, it is well to take heed from history.

Ignoring the depressions from earliest history down to the beginning of our own country, we find an abundance of pointers in the six major depressions prior to this one which have occurred in the United States of America since the Declaration of Independence was signed.

The first one began almost before the close of the Revolutionary war and was not ended until the adoption of the Constitution in 1788 and the Acts of the first Congress in 1789, which provided for the payment of all government debts, a balanced budget and the resumption of specie payments.

The second depression came in 1817 as an aftermath of the war of 1812, with its great issues of depreciated paper money, and suspension of specie payments. The third came in 1837 and was the result of the uncontrolled issuance of paper money by state-authorized banks, and wild speculation in government land.

The fourth depression came in 1857, and again the cause was primarily a great increase in the issuance of bank notes of more or less questionable value and the large amount of gold that was being produced in California. The fifth one began in 1873 and was an outgrowth of the excessive issuance of the depreciated "green back" paper money during and after the war between the states and the tremendous surge of speculation and the heedless running into debt that resulted.



C. W. Baldridge
President

As assistant engineer on the Atchison, Topeka & Santa Fe System, Mr. Baldridge's principal duties are concerned with rail renewal allotments

The sixth depression, which was recent enough to be within the memory of many of us, began in 1893 and again an increase in the volume of money in circulation due to the continuation of the 336 million dollars of green back paper money, the issuance of between two and three hundred million dollars of national bank currency and the coinage of more than 400 million silver dollars and a large output of gold from the many mines in the western part of the nation, seems to have been the incentive for the reckless spending and the over assumption of debts, which have preceded each depression. The seventh depression, the one which we all know about and would like to forget, began in 1929 and the end is not yet accomplished.

Every one of these six depressions was the result of an over-issuance of money and of reckless speculation and heedlessness about going into debt, by both the people and the Government, usually accompanied by depreciated money and always by depreciated, or loss of, credit. In all past depressions the cure has been the practice of economy, reduction of government expenditures, a balanced budget and the resumption of specie payments, which means of course the re-establishment of sound money. Is there any indication of such an end to the present depression? Again history may give a clew.

The Outlook

John V. Neubert, chief engineer maintenance of way, New York Central Lines, New York, who spoke before the evening session on September 18, touched on the outlook for the future of the association. He complimented the members on what they had accomplished in the past, citing statistics on the reduction in the number of train accidents between 1924 and 1933, inclusive, that have been ascribed to defects in or improper maintenance of tracks and roadway.

He declared also that there was no occasion for concern regarding the future so long as the association continued to do constructive work. There is no reason to fear that the American Railway Engineering Association will absorb the prerogatives of the Roadmasters Association, he continued, because the economical application of materials and efficient employment of labor rest largely with the supervisory officers, and the managements must look to them for the prudent expenditure of every dollar that is appropriated for track maintenance. There is need, he concluded, for the scientific study of maintenance of way, but there always has been and always will be a need for plenty of common sense, and "I know of no one in railway employ possessed of more common sense and better able to apply it than are the members of this group."

Address of S. T. Bledsoe

Railway managements were represented on the program by S. T. Bledsoe, president of the Atchison, Topeka & Santa Fe, who congratulated the members of the association on their success in maintaining the roadbeds and tracks in safe riding condition in spite of limited funds. There

must come a time eventually, he continued, when the accumulated needs of maintenance become greater than the accumulated amount of the cost reduction. At this point extraordinary expenses must be undertaken to bring track and roadbed back to reasonable levels of excellence of maintenance and still greater expenditures will be necessary to bring it back to their former standards of maintenance.

There is some encouraging evidence, he declared, that we have now turned the corner and that we may soon expect an increase in traffic. Any permanent increase in traffic will bring the need for heavier expenditures for roadbed and track. Every railroad in the country would be happy to restore its roadbed, track and equipment to the condition they were in in 1929. In fact, this desire is ever present but with depleted revenues no road has been able to do this. The railroads of this country have made a remarkable showing in the movement of traffic during the difficult years which we hope are behind us. This has been done in the face of decreased traffic, owing not only to the depression but to the diversion of a large proportion of railway business to competitors. Railway men have been alert to the fact that the only means at their command to combat this competition has been to improve their service. They are also aware that they are going to continue to have the keenest sort of competition and that the developments in improved service must be continued without abatement. The railways of this country owe no apology to anyone for their present service, but they must exert their energy to the utmost to improve service still further to meet the desires of patrons as well as to meet the competition that they are facing. In fact, it will be necessary for the railroads to maintain a service that will excel all forms of service which their competitors can devise.

At the closing session of the convention officers were elected for the ensuing year as follows: President, Armstrong Chinn, chief engineer, Alton, Chicago; first vice-president, B. E. Haley, general roadmaster, A.C.L., Lakeland, Fla., second vice-president, W. O. Frame, district engineer maintenance of way, C.B. & Q., Burlington, Ia.; and treasurer, E. E. Crowley, roadmaster, D. & H., Oneonto, N.Y.; while T. F. Donahoe, supervisor of road, B. & O., Pittsburgh, Pa., was re-elected secretary. R. H. Carter, acting division engineer, I.C., Chicago and A. H. Peterson, roadmaster, C.M.St.P. & P., Chicago, were elected members of the executive committee for four years; while W. C. Pruett, general foreman, M-K-T, Muskogee, Okla., and J. J. Clutz, supervisor of track, Pennsylvania, Trenton, N.J., were elected members of the executive committee to fill vacancies. Chicago was again selected as the place for the next convention.

The following topics were chosen

J. J. Desmond
First Vice-President

Armstrong Chinn
Second Vice-President

T. F. Donahoe
Secretary

J. P. Corcoran
Treasurer

Roadmasters' Association

Officers 1934-1935

C. W. Baldridge, President, Assistant Engineer, A.T.&S.F., Chicago.

J. J. Desmond, First Vice-President, Division Engineer, Illinois Central, Chicago.

T. F. Donahoe, Secretary, Supervisor of Road, B.&O., Pittsburgh, Pa.

J. P. Corcoran, Treasurer, Supervisor, Alton, Bloomington, Ill.

Executive Committee

Elmer T. Howson, Past President, Editor *Railway Engineering and Maintenance*, Chicago.

Terms Expire September, 1938

W. O. Frame, District Engineer M. of W., C.B. & Q., Burlington, Ia.

F. B. LaFleur, Roadmaster, S.P., Lafayette, La.

(Terms Expire September, 1937)

B. Esbenson, General Roadmaster, U.P., Salt Lake City, Utah.

W. H. Sparks, General Inspector of Track, C. & O., Russell, Ky.

(Terms Expire September, 1936)

G. T. Donahue, Assistant Division Engineer, N.Y.C., Watertown, N.Y.

J. J. Davis, Sales Engineer, Illinois Steel Company, Chicago.

(Terms Expire September, 1935)

A. A. Johnson, Engineer M. of W., D.L. & W., Hoboken, N.Y.

P. J. McAndrews, Roadmaster, C. & N.W., Sterling, Ill.*

*Died July 11, 1935

for study and report at the next convention:

1. Preparing and maintaining track for high speed operation.
2. Selecting and training foremen.
3. Inspection of rail—Factors to consider and inspections to make to determine when rail should be relaid, or the measures to be adopted to extend its life.
4. The use of work equipment to secure the greatest economy in track maintenance.
5. Curve Lubricators—Their economy; considerations affecting their installation.

Following are abstracts of the committee reports and some of the papers presented, with the exception of a paper on The Place of the Railroads in Today's Transportation Picture by G. S. Fanning, which will be published in a forthcoming issue.

The Handling and Distribution of Ties

From the Treating Plant or Storage Yard to the Point of Use

Report of Committee

TIE renewals have always been of the greatest importance to the railways. They constitute one of the largest single items of maintenance of way expense. The short life of untreated timber early became a source of great concern, since its use necessitates large scale tie renewals. In the beginning, the treatment of ties was not brought about so much by the scarcity of timber as by the desire to reduce the heavy labor cost of tie renewals. This heavy cost has brought most of the railroads to the use of treated timber for cross ties today. As a result of the work of tie and timber men in developing treating methods, and in improving handling and distributing methods, as well as greater care in their insertion in the track, the life of ties has been extended from 6 or 7 years untreated to 20 years or more treated.

Statistics show that during the last ten years our tie renewals have been cut in half. This does not mean that the life of ties has been doubled during so short a period by better treatment and handling alone, for there are a number of other reasons contributing to this startling result, including the abandonment of branch or unprofitable lines, the reduction in the volume of freight and passenger traffic handled, improved and heavier rail sections, tie plates and joints, and the use of sufficient rail anchors to retard rail creepage. All these have so greatly reduced our tie renewals that they will never again attain the proportions of former years, or at least, the peak of 1922. We cannot lose sight of the fact, however, that there is a considerable accumulation of deferred tie renewals along with other deferred maintenance, for which present business conditions are responsible. No doubt as the railroads return to more prosperous times we will see an increase in tie renewals to overcome this deferred maintenance.

There are many ways in which the life of ties is reduced after they leave the treating plant or storage yard.

E. L. Banion
Chairman

Such conditions are brought about by improper handling and distribution after the ties leave the control of the tie and timber department. While there are instances where ties have been held in storage for a number of years after treatment, this is usually brought about by anticipating a requirement for a certain grade of ties that did not materialize. Ties held for a long period after the required seasoning will deteriorate, the rate depending on the manner in which the ties are piled, the kind of wood and the treatment. Ties should be inserted in track as soon as possible after any necessary seasoning.

Many ties are damaged in unloading and distribution by being dropped on old rails along the track, thrown down fills, or being unloaded in rocky cuts or other locations where they are split, bruised or splintered. It is preferable to drop them from cars so they will strike the ground along their full length rather than on end. Quite frequently they are damaged when dropped from unusually high loads in open top cars.

Any attempt to fix a definite time at which ties should be moved from the treating plant will arouse a great deal of justifiable opposition for several reasons, including principally the manner in which annual renewals are made, the practice followed in distributing ties when received, the season at which suitable equipment is available for shipping the ties, the methods in use at the treating plant, and other reasons arising primarily from the operating conditions on each railroad. Generally speaking, shipment should be made to the point of use during the fall and winter months in order that renewals may be started as soon as possible after the frost is out of the ground and not be held up waiting for ties or time to unload them. This may not be practicable, in extremely cold climates, because of long periods of heavy snow and frozen ground; under such circumstances ties should be received during the late summer or early fall.

The practice of furnishing ties only as needed works well where they are unloaded and piled at stations for distribution later by motor car and trailer, but where it is the practice to

Some Roads Store Ties at the Treating Plant After Treatment

make the distribution direct to the actual point of use by means of a work train or a local freight, it would seem more practical to furnish the entire allowance at the one time. While this will place an unusual burden on the treating plant, it is justified by the saving in train service.

How to Distribute Ties

The proper manner of distributing ties when received will always involve a difference of opinion among the various railroads and will be governed by the same conditions that determine the proper season for shipping ties. Where practical, ties should be unloaded as close as possible to the actual point of use to reduce extra handling. On two large northern railroads, a very satisfactory arrangement has been worked out wherein practically all tie insertions are made by special tie gangs, incident to which ties are trucked direct from the cars or from storage piles at stations to the point of use by motor trailers in advance of the special tie-inserting gangs. The low renewal cost attained speaks very favorably for the special tie gangs and their manner of distributing ties. However, this practice would possibly not be satisfactory to some roads, without complete revision of their practices of maintenance.

A canvass was made among maintenance men in various official capacities on 33 railroads to ascertain their opinions as to the proper manner of distributing ties, the following question being asked, "How are your ties distributed when received from the treating plant or storage yard? Piled at stations? Unloaded by local or work train at the actual point of use?" A study of the replies shows that 6 favor the practice of unloading ties at stations and trucking them to the point of use on motor trailers, 17 prefer to use a work train or local freight to unload them at the actual point of use, 4 favor using the method best suited to local conditions, while 6 favor placing at the actual point of use, but did not indicate the method to be used.

Ties should never be unloaded between stations except at suitable locations, and unless they are to be used soon they should be piled and given the same attention as if unloaded at stations. Ties should never be thrown indiscriminately out of cars down fills, or in cuts where they will block drainage and require moving.

There are good reasons for unloading ties at the point of use between stations, particularly in the sparsely populated districts of the West, where stations and sidings are far apart. On many long sections where track forces have been reduced there are seldom sufficient men to handle the motor car and trailer, and furnish the necessary flag protection to truck them long distances. If a careful check is made by the roadmaster or supervisor of the number of ties to be inserted in each mile of track prior to the time the distribution is made, the unloading can be handled by work train or local freight, from 10 to 25 ties being unloaded at a time at as many locations as necessary to the mile. Ties to be inserted in the immediate vicinity of stations should be unloaded and piled at the stations, for they should not be scattered through the yard. It is also a good policy to hold 50 ties at each station for emergency use after the general renewals are made. If not required for this purpose, they can be inserted in the vicinity of the station when the next tie allotment is received.

In the heavily populated industrial districts where stations or tracks are only a few miles apart and where space is not available for storing ties on the right of way, it would no doubt be more practical to unload the ties at the stations and truck them out to the point of use as needed.

It is commonly agreed that there are few, if any, cars better suited for the shipment of ties than low-side open-top cars. Cars ordinarily used in the coal trade, except gondola and hopper bottom cars with extremely high sides are well suited for this purpose. Mill-type cars with sides four to five feet high are also well adapted for tie loading but are seldom available. The cost of loading 400 ties in a closed car at the treating plant by hand approximates $6, while the same number of ties can be loaded in an open-top car with a crane for $2.50. If, however, open-top cars are staked and wired to increase the capacity, the cost will be increased $1 to $1.50 per car.

One large railroad uses specially-built steel frame tie cars to a limited extent. These cars are open-top and may be loaded by hand or crane. They hold a large number of ties and do not require staking or wiring as flat or coal cars do if loaded above their sides. These cars were built particularly for transporting untreated ties from the right of way to the treating plant. While these cars possess certain advantages, the same disadvantage adheres to this class of equipment that applies to any other class of equipment not moving in commercial trade or under load in treating plant territory, in that a return haul empty is necessary. Since such special tie cars are seldom suited for commercial loading, they are even more objectionable from this standpoint.

The use for tie loading of the equipment best adapted for that movement is restricted during a large part of the year by its demand for commercial service. Coal cars are seldom available when there is a heavy coal movement. In the West where stock cars are widely used for handling ties, they are not available during the stock rush. During certain seasons ties can move with the tide of empty cars. At other seasons a return haul empty is necessary if certain preferable types of cars are to be used. At the four treating plants from which ties are furnished for one large railroad system, one plant is furnished stock cars almost exclusively, another plant loads no stock cars but uses principally coal cars, while at the other two plants both stock and coal cars are loaded, depending on the season and availability of cars.

The use of "battle ship" type or extremely high side coal cars or gondolas, as well as hopper bottom cars,

Most Roads Prefer to Unload Ties at the Point of Use When They Are to be Inserted Promptly.

for loading ties should be prohibited because of the danger to men when unloading ties from them, as well as the damage to the ties. The same applies to low side cars that are wired and staked to carry loads extending high above the top of the car. Clean box cars should not be used for loading treated timber, as creosote and oil-treated timber may contaminate the cars for many commodities commonly carried in such equipment. Rough box cars may be used for shipping untreated timber or ties, but men find it difficult to work in closed cars when they are loaded with creosoted ties, as the fumes cannot escape readily.

Ties that have been unloaded at stations for distribution between stations may, where train service will permit, be reloaded on flat cars and distributed by local trains. They can then be unloaded at a very small cost as compared to ties loaded in any other class of cars. Loading rules usually prohibit the shipment of ties on flat cars

for any long distance, unless a large amount of staking and wiring is done, which is costly.

It is difficult to formulate any set rule for the class of equipment to be used for hauling ties, for this must necessarily be governed by the class of equipment available at the time the distribution is to be made. However, where practical, low-side flat-bottom coal cars should be given preference, for quite a saving can be made by maintenance of way forces in unloading.

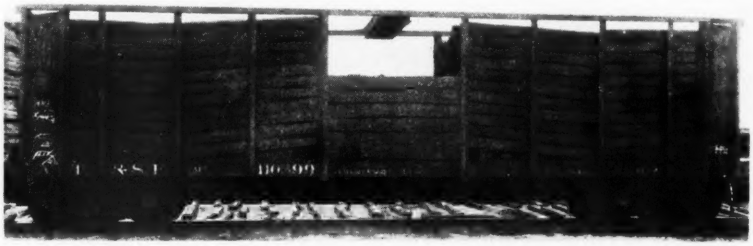
Many personal injuries have resulted to men handling ties that were loaded improperly in cars. Creosoted and oil-treated ties are hard to handle at best and when placed on end in cars, the difficulty of unloading is increased. Almost equally hazardous is the practice of placing them crosswise in closed cars, piled high above the car floor. From the standpoint of safety, particularly when the ties are to be unloaded from trains, this committee does not recommend the practice of increasing the load in low-side open-top cars by staking such cars, placing ties on end and wiring them high above the side of the car. As a general practice, it is our recommendation that all ties be placed lengthwise in cars except those loaded in closed cars, in which case two tiers of ties should be placed length-wise in each end of the car, with those in the door space placed cross-wise to facilitate breaking the load, and the height of the load not to exceed six feet above the car floor.

A number of years ago when treating plants were operating to capacity and there was a scarcity of storage space at the plants, some railroads operated a number of other storage yards, the purpose of which was to provide storage for ties within a reasonable distance of the point of use. Of late years there has been little need for such yards. This has been due in part to the construction of new plants at strategic locations from a system supply standpoint, and in part to the decrease in tie requirements for some years past. The practice of shipping ties direct from the treating plant to the point of use is believed to be the most economical, both in the handling of the ties and in storing them in the best manner, including consideration of protection against fire. It is not necessary to season ties treated with cerosote and oil after treatment, but it is the consensus of opinion that ties so treated should not be used for 60 days after treatment, if for no other reason than to allow them to dry, for this will facilitate handling and will eliminate many of the creosote burns suffered by men handling freshly treated ties direct from the retorts to the point of use. Ties treated with zinc chloride or other water-soluble salts should be seasoned for at least 60 days in an open pile before being inserted in track.

Ties that are to be held on hand for several months should be piled, regardless of whether they are unloaded at stations or between stations, as ties scattered along the track, unless they are to be used in the near future, will be in the way, and may be damaged by fire or moisture. Ties stored in piles should be placed at locations free from inflammable materials and where water will not stand around the piles. Most railroads require that tie piles be placed 50 ft. apart, unless there is adequate fire protection, and that the piles be far enough from the tracks that they will not interfere with persons using the tracks. However, it is a mistake to place the piles too far from the track as this consumes extra time in unloading and reloading the ties.

The proper method of piling ties depends on the treatment, the climate and the amount of seasoning necessary. Creosote and oil-treated ties usually require close piling and should not be exposed to the direct rays of the sun. The covering of the top layer of ties with an inch of sand, dirt or cinders will afford the necessary protection. Ties treated with zinc chloride and other salts usually require additional seasoning, and should be stored in open piles with minimum contact and the outside ties in each tier turned on edge to allow the air to circulate freely through the pile.

Because of the relatively small number of untreated ties now being used, the committee does not feel that a separate discussion of their handling and distribution is necessary, especially since the methods to be followed do not differ materially from those for treated ties. Likewise, any consideration of switch ties would be out of place in this report and would only serve to confuse, as the methods required here differ greatly from those employed in handling and distributing cross ties.



The Use of Open-Top Cars for Transporting Ties Offers Economies in Loading

Committee—E. L. Banion, (chairman), roadmaster, A. T. & S. F., Independence, Kan.; G. L. Griggs, Jr., roadmaster, C. B. & Q., Centralia, Ill.; J. P. Davis, supervisor, C.C.C. & St. L., Harrisburg, Ill.; Wm Anderson, roadmaster, U. P., Montpelier, Idaho; R. E. Meyer, roadmaster, C. & N. W., Wall Lake, Ia.; Jos. M. Miller, supervisor, West. Md., Westminster, Md.; W. H. Sparks, general inspector of track, C. & O., Russell, Ky.; W. L. Spyres, roadmaster, K.C.S., Heavener, Okla.; A. W. Wehner, roadmaster, S.P., Lake Charles, La.; E. L. Farmer, roadmaster, St.L.S.W., Lewisville, Ark.; W. H. Jones, roadmaster, A.T. & S. F., Chillicothe, Ill.; S. Payson, roadmaster, S.L.-S.F., Enid, Okla., and E. C. Buhrer, supv., N.Y.C., Sandusky, O.

Discussion

J. J. Clutz (Penna.) stated that on the Pennsylvania, ties for renewal are inspected, indicated and recorded by miles and telegraph poles. From month to month the supervisors make requisitions for the ties that will be required during the following month, indicating point of shipment and date required. These ties are then distributed directly at the point of use. M. M. Killen (G. C. & S. F.) questioned the advisability of shipping the entire allowance in advance of the renewal season, where it is the policy of the road to ship the ties directly from the plant to the point of use. J. B. Martin (N.Y.C.) also questioned the desirability of distributing ties too far ahead of use, advocating delivery just prior to the date of renewal, to eliminate much of the splitting which now occurs, particularly in hardwood ties. He stated that ties are not so much subject to splitting when in the track, because they are enclosed in the ballast section and do not dry out so rapidly.

Earl Crowley (D. & H.) suggested that where there are no treating plants on the line, a road is not always in position to control either the time or rate of shipment for which reason the ties must be taken when it is necessary for the plant from which they are secured to make the shipment.

He said that few commercial treat-

ing plants have sufficient storage space to permit them to store ties for all of their customers and that they must, therefore, make shipments currently when the number of ties being treated exceeds the storage facilities. Mr. Martin replied that some roads specify definite dates and rates of shipment and he thought that in most cases similar arrangements could be worked out.

J. L. Gallavan (U. P.) stated that it was the custom on his road to distribute ties by work train directly at the point of use. If they are received far in advance of the date of renewal, they are stacked in piles of three and allowed to dry out. Otherwise, they are left as unloaded until the tie renewal gang uses them. T. Thompson (A.T. & S.F.) described the system used on the Santa Fe which is to ship ties according to a pre-arranged schedule which is specified on the requisition upon which the ties are distributed. They are unloaded at stations and distributed to the point of use as needed. E. Rost (B. & O. C. T.) called attention to the fact that in the great majority of cases the ties must be treated well in advance of use, because the capacity of treating plants is seldom sufficient to permit the treatment of all ties required during the renewal season. Mr. Banion said that his experience indicated that it is desirable to allow ties to dry out before shipment. This avoids the complaint so often made by the men who are required to unload newly-treated ties particularly those that are creosoted, that the creosote damages their clothes and burns their skin. E. P. Safford (N.Y.C.) also emphasized the fact that treating plants must treat ties months in advance of use in order to treat all that will be needed during the season. A. Chinn (Alton) called attention to the fact that, aside from the time element which had been emphasized by the previous speaker, ties must be treated as soon as seasoned; yet they cannot always be shipped from the plant at this time and adequate storage facilities should be provided to take care of the maximum number of ties that must be stored between the date of treatment and the date of shipment.

W. T. Eldridge (I. C.) told of some of the difficulties which are encountered when local trains are depended on for the distribution of ties, stating that the time lost by the maintenance forces sometimes greatly exceeds the time involved in trucking ties out from stations, in addition to breaking into the routine work scheduled for the maintenance force.

Track Maintenance, Today and Tomorrow

By C. J. Geyer

Engineer Maintenance of Way, Chesapeake & Ohio, Richmond, Va.

IT IS the practice on modern railroads to prepare an annual maintenance budget and to have a fixed work program. A detailed inspection is made of the roadbed, ballast, ties and rail, but I sometimes doubt if we attach enough importance to this phase of our job. We must plan for uniformity in maintenance in keeping with the requirements on the railroad as a whole, so that each division of the same class will be maintained at the same level.

The annual budget is prepared from the notes of this inspection, showing by items the amount to be spent and the programmed expenditure for each month of the year. Such a program will enable a roadmaster to check his progress very quickly and also determine the efficiency of each gang. It also allows the orderly purchase and distribution of materials so there will be no lost motion in changing from one job to another.


C. J. Geyer

I am afraid that we often lose sight of the economies that can be effected by this program and budget plan as compared with the month to month allowances that vary with the fluctuation of business. A little thought on what happens when forces are suddenly cut or expanded will give you some idea of the total cost. To illustrate—a roadmaster has a gang of 30 men working on a job of two or three months' duration. Material for the job is distributed. He gets orders to cut off his force. It is necessary for the roadmaster to leave his routine work and make arrangements to disband the force, close up the camp cars and ship the tools to headquarters. All of this requires some labor expense. The material for the job is left along the right-of-way, representing dead money. Later the roadmaster receives authority to re-establish this force, and the above operation is reversed, except that he finds some windows broken out of the camp cars and probably other damage and depreciation, and a great many new faces in the gang. There is then a period of low production, with consequent loss. Multiply this loss by all the gangs on the railroads and repeat it two or three times each year, and we can see that at least 10 per cent of the expenditure is wasted. Probably the figure is nearer 25 per cent.

Will It Serve?

There is another feature of present-day maintenance somewhat related to the program and budget. That is the kind of material or machinery or type of structure that will be used. In the last analysis, there are just two factors to consider in deciding the type of unit to use: (1) Will it serve the purpose? (2) Will its annual cost be less than another type? You may decide the first by observation, by test, or by some other means. To decide the second, you must have a pretty good idea of the life that may be expected from the unit in question. Now, if you have to get more than 30 years' life out of a certain unit to make its annual cost equal that of some other type of shorter life, but costing less money, it is doubtful if it pays to buy the higher priced article.

The modern railroad is keeping a close check on its maintenance costs. I do not mean the costs as reflected by charges to the I. C. C. accounts, but the actual cost of each class of

work done by each gang. This is not an expensive operation because the reports that are needed for this purpose are also required for accounting purposes. It simply means one additional man on each division or subdivision to find the unit cost from the foreman's time sheets and material reports. This man usually acts also in the capacity of an assistant roadmaster. Incidentally this is good training for future maintenance officers. The operation of this system is simply the allocation of each gang's total time to specific jobs, as reflected in the foreman's distribution of time. There is no chance to fake the result, because failure to charge time properly on one operation will simply raise or lower the cost on some other operation and the error is readily detected. The advantage of this scheme lies in the increased efficiency in the performance of all maintenance jobs and the resulting lower costs. This is brought about by a detail time study of those gangs having low costs for any particular operation. This study generally shows that the foremen in charge follow methods somewhat different from those generally accepted, and this knowledge is passed to all foremen doing that work.

Safety

Any discussion of the modern railroad is incomplete without some reference to the "safety movement." The progress in safety for the workers on American railroads in the last 10 years has been remarkable. It has added to the happiness of thousands of railway homes. It has been worth many times its cost from a humanitarian view point, but let me tell some of you hard-hearted fellows, lack of safety costs you real money in your maintenance work. There may not be a place where this cost is recorded so that the roadmaster sees it, but just as certainly as the cost of a damaged motor car or track machine is charged against your maintenance expenses, so is the cost of service given an injured man and the expense of training another in his place deducted from your allowance.

The subjects I have attempted to outline in a general way—morale of maintenance men, standards, programming of work, cost of individual jobs, safety—are all a part of the track maintenance problem of today. I think the old-time maintenance men will agree that there is a big improvement in maintenance work and results. These older men should feel proud because they laid a sound foundation for the modern railroad.

Maintenance, Reclamation and Repair

of Frogs, Switches, Railroad Crossings and other Track Material and the Economic Limitations of this Practice

Report of Committee

FROG, crossing and switch construction has changed as the track structure has changed. Frogs and crossings are today of much better construction in comparison with the rail in service than were the frogs and switches of the past, measured with the lighter sections of rail then employed. It is within memory that frogs and crossings were fastened on plates by riveting, with few braces, in contrast with our present railbound frogs with filler blocks and good bolts, or our solid cast manganese frogs, or the cast steel or alloy frogs that some companies use.

Walter Constance
Chairman

The Foundation

Some railroads report that the best expedient they have found to reduce the maintenance of crossing frogs is the use of concrete foundations under the crossings, with 12 in. of ballast between the foundation and the bottom of the ties. With this construction they use 8-in. by 10-in. ties and clean the ballast every year. Other railroads report that the same construction has proved of no benefit.

Some roads place special timbers up to 20 in. wide under crossings, while others have removed them and substituted 8-in. by 10-in. timbers to facilitate surfacing since it was almost impossible to tamp under the 20-in. timbers. Various ways of placing ties have also been tried, some companies placing the timbers diagonal to the lines of travel while others place them straight across and continuous with the heavy traffic, always leaving sufficient space between them to permit tamping the ballast.

One large eastern railroad reports the use of framed timber foundations, stating that "these consist usually of two 10-in. by 10-in. treated timbers bolted together under each rail of the heavier traffic line, with two 10-in. by 10-in. timbers framed into the first timbers and bolted together under the other running rails. We have used a concrete slab, usually precast, in some cases, but believe that the heavy timber foundation will usually be sufficient." A large road running through Louisiana reports that it uses a timber frame but drives piling for a foundation, thus preventing sloppy conditions at the crossing.

The very important problem of drainage is solved in many ways, each crossing being an individual problem. Some roads lay drain pipes to sumps, other roads report that they keep the ballast clean, and still others report that they keep the ditches open. At best, they do what they can to maintain the frogs in alignment, properly surfaced and drained.

Various types of continuous rail crossings have been tried, including two with sliding blocks which move to close the flangeways of the track being crossed, thus permitting the wheels to pass over the crossing without the customary jolt; another type of crossing has a revolving block arranged in each corner which turns to provide a continuous tread for the wheels as they pass through the crossing. Some device of this nature, if of durable construction and so designed that there can be no failure to operate

correctly, should go far toward solving most of our crossing problems. Where it can be used, the so-called puzzle switch, or movable-point crossing, is generally found to be the best construction yet devised.

One large eastern railroad mills a recess in its stock rails to provide a housing for the protection of its switch points. This is a refinement of the bend usually put in stock rails. Protectors are also welded to stock rails to provide the same effect as the milling of the rail. A switch point and stock rail are manufactured with a bevel planed on the underside of the stock rail, with the point so beveled as to fit this planed section of the stock rail. This provides a heavy section at the lower side of the ball at the point of switch and the load is carried on the stock rail with little wear. This installation has proven very economical as well as safe.

Some railroads have found that keeping the switch points and points of frogs greased, especially on curves, increases their service life. Another measure for prolonging the service life of switch points is to keep the ball of the stock rail against which the switch point fits, free from overflowing metal by grinding it away. The overflow on switch points is also ground off to maintain the proper height of the switch point in relation to the stock rail.

Switch point protectors are used by many roads in practically all of their yards but not on their main line tracks. Guard rails are sometimes placed opposite main line switch points in such a manner that the end of the switch point will not be worn away so rapidly. Manganese protectors with a flange that extends up beyond the outside of the rail have also been successful in many cases, although there are some objections to this type of protector. Protectors bolted or welded on the side of rails are effective in yards. A number of roads advocate the practice of bending switch points to fit curves of 14 deg. or more, claiming that otherwise switch points break when installed on sharp curves.

Reclamation

Nearly all of the railways repair open hearth frogs by welding, some using gas and others the electric process. As early as 1914, experiments were made with the welding of frogs but the process was not brought to a practical basis until about 1917. In the gas welding process, the repaired surface of the rails was first smoothed and brought to the correct height by the use of a blacksmith's flatter, or some special design of such a tool. Electric railways and street car lines, with electric current available, soon began to build up their worn rail ends, crossings and frogs by electric welding processes. It was soon found, however, that with the electric process the added metal could not be placed smoothly enough for good results. It

Many Roads Increase the Service Life of Switch Points by Grinding Away Overflowed Metal on the Stock Rail

was also found that a flatter did not suffice for smoothing up the rail because it was impossible to keep enough of the metal hot at a time to allow it to be hammered down. An electrically-driven portable grinder, which had been used for some time for bringing uneven rail ends to the same height, was soon adapted to the removing of the surplus metal and producing a smooth face on the repaired rail. The difficulty of building a gas-welded rail end to the exact height desired by the use of a flatter, since the outside cold metal would not yield to the forging, has led, in many cases to the adoption of grinders for finishing all kinds of welds, until the grinder is rapidly proving to be an economical and useful machine wherever rail, switch frog or crossing repair work is being done.

Manganese frogs are welded successfully by the electric arc, although there has been much experimenting with gas welding, without success to date. Some of the roads provide their own equipment for electric welding while others do their work by contract. Some of the roads that prefer to do their work by contract, claim that this is more economical while others report that they can do the work more cheaply with their own forces. The tendency is for the railroads to own and operate their own welding and grinding equipment for the reason that manganese welding, in spite of all of the progress that has been made, still has many failures—small failures shall we say. As an example, a crossing frog is given an entire overhauling. In a short time one point of the frog may fail, so that repair work is necessary. It is sometimes difficult to get a contractor back to repair a small break after he has moved some distance away, possibly to another road. To guarantee work of this kind it is necessary for a contractor to place the initial cost of repair high enough to cover such small follow-up work as may, and often does, follow general repairs to both crossings and frogs. This fact has stimulated the purchase of company-owned equipment for frog and crossing repairs. One large road in the east has recently purchased 11 units for frog and crossing work exclusively, while other roads have bought smaller numbers. A large western road adopted the electric welding practice exclusively three years or more ago, although it had been among the heaviest users of the gas-welding process previously.

Some roads do not use repaired frogs in main tracks while others use them there and even make repairs under traffic. Some roads do not attempt to weld worn spots on switch points while others find it profitable not only to repair frogs and switch points in main line but also to weld worn spots on points. Those which repair switch points by welding insist that it is more practicable to do this than to repair frogs since the stock rail carries most of the load passing over a turnout and state that such work is safer than welds on railbound manganese frogs. However, most of

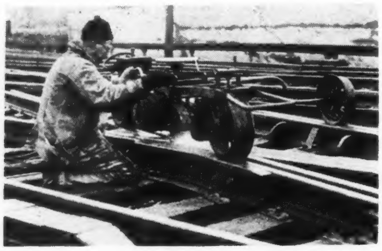
Gas Welding Is Widely Used in the Repair of Worn Frogs

this work is done when points are removed from track.

Street railways were the first to weld manganese inserts in their frogs, using the electric weld because current was available. A transformer, or series of grids for changing the current from the high voltage and low amperage to low voltage and high amperage, is necessary for welding. This type of welder is also used to make continuous rails by welding

joint bars to the rails. It was a natural step from repairing joints to repairing manganese centers. However, when welding was done with this type of equipment on the steam railroads it was soon found that it did not stand up as well under the heavier loads of the steam roads. The reversal of polarity, which gives best results with direct current welding on manganese, is not possible with the grid type of equipment. Some street railways now use motor-driven types of welders and they are used almost universally on the steam railways by substituting gasoline engine units for the power motor which electric lines employ to operate the welding unit. Alternating current grid type transformers are said to work well on manganese work, although they have not been used much yet. Many attempts have been made to weld manganese crossings and frogs with the gas blow pipe or torch with indifferent success although the weld can be made to look good and last for a time. In one case a frog lasted eight years under light traffic.

The nature of Hadfield manganese steel with 11 to 14 per cent of manganese, such as is used in crossings, frogs and inserts for switch points is such that when cast and taken from the molds it is easily broken. It is rendered tough and hard by heating to about 1,800 deg. F. and quenching. When reheated to as much as 750 deg. F. it again returns to the original brittle state. When welded by the gas method the parent metal breaks down



Electrically-Driven Grinder Removing Surplus Metal

and allows the welded portion to break out below its junction with the parent metal. This is true also, to some extent of electric welds.

Many measures have been tried to eliminate breaking, including the welding of only a small portion of metal at a time, then moving to another place on the crossing while the welds cool. The older types of welding rods were quenched while hot; welding rods containing 3 to 4 per cent of nickel and some Molybdenum have proven capable of preventing the breakdown of the original metal in the frog. The first successful manganese frog welding was done on an ore-carrying road in Minnesota in 1922. When contractors commenced to weld rail joints electrically in 1923, they were asked also to weld manganese crossings and frogs and have developed a very successful method.

The procedure for repairing manganese frogs by welding is becoming standardized and a number of good welding steels are now available. In some of the early work insufficient care was exercised in cutting away metal that was damaged or cracked but had not yet broken out. The weld thus made was improperly bonded and weld failures occurred frequently. Since more care is being exercised, failures are infrequent.

The tendency is to use larger welding units than was the practice at first, although many still prefer the lighter machines because they are easier to handle.

A number of roads which operate shops for the purpose of repairing frogs remove the frogs from track and send them to the shop where new parts can be made and the frogs given complete and thorough overhauling. On such roads, no attempt is made to weld frogs under traffic if they are in a bad state of repair. Other roads which have no central repair shops try to repair in track frogs that are in such condition as to make repairs rather expensive.

Those roads that do not repair or weld frogs in track but in all cases replace the worn frogs and send them to a shop to be repaired, consider the welding of frogs in track to be more expensive and less satisfactory. However, other railroads prefer to weld frogs in track for two reasons—(1) The frogs may be repaired in track for the same or less cost when the expense of changing them out and handling them to and from the shop is included and (2) a frog that has served in track until in need of repairs is usually worn to the same extent as the adjoining rails and is well seated on the ties, thus producing good line, surface and gage. If a new or a repaired frog is substituted, some time will be required for it to attain these conditions. Also a change of frogs causes damage to the ties from respiking. Possibly the best practice is to make repairs in track where only the manganese points and the throats of the frogs are worn or fractured and to send all frogs to a shop for repair that need new parts or rivets renewed in plates.

Practically all roads prohibit the burning of holes in rails because of the frequency of rail failures resulting from that practice. The same rule is generally applied to parts to be used in frogs or crossings. Workmen are now required to drill the holes or heat the rails to a red heat before holes are burned. The cutting of rails with a torch in lieu of nicking and breaking in the usual manner is less dangerous to the rail than the burning of holes, although many roads still prohibit this method of cutting rail. When the base or ball of

Several Roads Employ the Electric Process in the Repair of Both Open-Hearth and Manganese Frogs

a rail is cut horizontally with a torch, it should either be preheated before cutting or annealed after cutting to prevent breakage.

The use of grinding machines operated by gasoline engines was long delayed due to the difficulty of eliminating or preventing excessive vibration, resulting from the gas explosions in the engine. Much improvement has been made in their construction and several makers now have quite successful machines of this type on the market. Among the conditions contributing to the rapid development of gasoline-driven grinders is the ease with which they may be moved along the track, since no wires or other appurtenances must be handled and the power cost can be stopped quickly when short delays occur. Another important argument for the use of gasoline-powered grinders is that the engine may be run at the proper speed to get the most efficient use from the grinding wheel. Most dependable electrically-driven grinders have the same spindle speed at all times.

A welding engineer on a large coal-hauling road in the east has built an electric grinder with a variable speed motor which can be regulated as readily as the gasoline grinder. Contractors have used electrically-driven grinders almost exclusively because they give little trouble and the large central power plant that furnishes power for the welding also furnishes it for grinding. A number of large roads that have bought this type of equipment especially for rail joint

welding also use it for frog and crossing repairs.

On a majority of the roads the welding of switch stand connecting rods or switch rods is not permitted. Switch stand castings or wrought parts are welded on some roads while this is not permitted on others. Much welding is done on tools and machines used in maintenance work, this practice often keeping the machines in service and preventing costly shipping of tools or machines to the shop. Hard surfacing of wearing parts on tamping tools, ditcher buckets and worn shovels is often done by maintenance welders who are regularly assigned to frog and switch repairs or to rail end welding. This work supplements repairs made in reclamation plants and shops generally and often saves considerable sums of money by keeping machines in operation. Small jobs of bridge welding are also sometimes done by these maintenance welders, although the bridge and building department usually handles these jobs with its own forces. Water service gangs also make use of some welding in their work.

The question as to who should have charge of the repair of frogs is answered differently on various roads. The committee's investigation indicates that the supervisor or roadmaster in direct charge of the territory should program the work which should be done. However, he should consult with the contractor's representative, if the work is done by contract, or with the company's welding supervisor where the company does its own work.

Complaint is sometimes made that welding supervisors repair frogs or crossings which properly were beyond repair. However, such repairs are sometimes justified because a replacement frog is neither available nor obtainable except at excessive cost. In order to keep a track in service or the road open, it is sometimes justifiable to spend more on repair than would be permissible otherwise.

To sum up, the committee believes that frogs, crossings and switches should be kept in service by welding in track wherever it is economical to do so; also that all frogs, crossings, switch points and similar material taken from service should be sent to the shops so that parts may be salvaged for use in the repair of other articles of similar kinds. This would be more efficient than it is if all of the materials were standardized, at least on the one road, so that parts could be interchangeable. Until this is attained, other new parts may be purchased or manufactured by the repair shop that will enable the articles to be returned to service in good condition at a considerable saving to the railroad.

The committee is of the opinion that the field is large and that rather than being over-done, there is not as much reclamation done yet as considerations of economy warrant.

Committee: Walter Constance (chairman), supervisor, C. & O., Barboursville, W. Va.; A. B. Chaney, division engineer, M. P., Poplar Bluff, Mo.; J. Morgan, supervisor, C. of Ga., Leeds, Ala.; Z. M. Briggs, assistant engineer, Pennsylvania, Pittsburgh, Pa.; M. Donahoe, division engineer, Alton, Bloomington, Ill.; O. R. McIlheny, Tennessee Coal Iron & R. R. Co., Birmingham, Ala.; F. Ivers, general roadmaster, OW.R.R. & N., Pendleton, Ore.; L. F. Barrs, roadmaster. S.A.L., Hamlet, N.C.; J. Haas, roadmaster, A.T. & S.F., Woodward, Okla.; H. A. Halverson, roadmaster, C. & N.W., Wall Lake, Ia.; C. F. Edwards, cost engineer, C. & O., Columbus, Ohio, and T. Thompson, roadmaster, A.T. & S.F., Joliet, Ill.

Discussion

This report was accepted as information with a suggestion that the Executive Committee consider its reassignment for investigation and report at next year's convention, and that if the subject is reassigned the committee be instructed to consider the development of cost data.

North Shore Reduces Truck Nosing

By H. A. Otis,
Engineer of Car Equipment, Chicago, North Shore & Milwaukee

SEVERAL years ago the Chicago, North Shore & Milwaukee opened an alternate high-speed passenger line through the Skokie valley, north of Chicago, to avoid the speed restrictions imposed on the old line by the fact that it passes through the streets of many of the larger towns which are located along the shore of Lake Michigan between Chicago and Milwaukee, Wis. Immediately, it was found that beyond certain speeds, depending on their weight and length, the cars began to "shimmy" and that this vibratory motion became so pronounced as to cause considerable discomfort to passengers.

Steps were taken at once to determine the cause and find what could be done to overcome the trouble. Through a process of elimination, which involved considerable time and effort, it was considered probable that the vibrations were being set up as a result of oscillations of the car wheels. For this reason, an extensive study was undertaken to learn what the action of the wheels is at high speed.

A section of tangent track laid with 100-lb. rail on stone ballast, level and in good line, surface and gage was selected for the tests. To study the motions of the wheels relative to the rail while a car was running at high speeds, permanent records were made with a superspeed moving-picture camera, which was mounted on the inside corner of the truck frame. This camera was adjusted to make 128 exposures a second, this being eight times as fast as the ordinary motion picture camera. Consequently, when the pictures are thrown on the screen with the ordinary projector, the movements of the wheels are viewed at one-eighth of their actual speed, thus permitting a careful study of their action.

For these tests a standard passenger car having large diameter wheels was chosen, the flanges and treads being partly worn. The series of pictures taken of these wheels, showed that at more than 60 miles an hour, the wheel oscillated back and forth across the rail, the flange contacting the rail and the tread then moving transversely across the rail as far as the flange on the opposite wheel on the same axle would permit. As soon as the opposite flange contacted its rail, the movement was reversed, resulting in a series of oscillations, the period of which was constant at the rate of three contacts a second between each flange and its rail. These oscillations did not start until the speed reached 60 miles an hour, and the frequency remained constant between that speed and 70 miles an hour, the highest speed that was attained during the test.

Wheels Turned

The car was then sent to the shop where the wheels were turned to the standard A.A.R. contour, with a straight taper of 1 in 20 on the treads. A similar test was then made over the same track and the pictures showed that while the wheels oscillated in the same manner, the oscillations differed from those of the worn

wheels, in that the side movements were neither so violent nor so constant, although they maintained the same frequency.

It was apparent from these two series of pictures that the slope of the treads and the difference between the wheel and track gages were factors in the nosing. The wheels were then turned so that the flange was slightly thicker than the standard and the tread taper was 1 in 40. The pictures then showed a marked reduction in the number and extent of the oscillations, which were gentle and soon broken up and that, in general, the wheels ran parallel with the track.

The car was then returned to regular service and after running 16,750 miles, another set of pictures were taken. Although some wear had occurred, the small amount of oscillation was not continuous. The wheels were next turned to obtain a standard flange and a flat tread without taper, when the pictures showed that the wheels ran with no oscillation, or occasionally at a very low frequency, and the flange seldom touched the rail. On this showing, the flat (cylindrical) tread has been adopted as standard, and the "shimmying" effect of high speeds has been entirely eliminated.

Earlier Days in Maintenance of Way

By B. E. Haley

General Roadmaster, Atlantic Coast Line, Lakeland, Fla.

MY SERVICE with the railroads goes back only about 35 years, more than 25 of which has been spent as roadmaster and general roadmaster. However, my interest in them goes back nearer 50 years, to the time when the news that a railroad was to be built, not far from where I lived on a small farm near the foot of the Blue Ridge mountains, was the cause of intense excitement. A few years later, the rumor became a reality, and on a long remembered day, some of the farmers decided to take the children over to see the train. We drove several miles to the head of the steel, and on the way over I heard my first lecture on safety, for we were told in detail just how far to stay from the track, along with other good advice, for none of the children and very few of the older people had ever seen a train. We found the train loading dirt in a cut. The locomotive was a wood burner with the biggest smokestack I have ever seen. When the train started up we were all lined up alongside the track holding hands, and as the train got opposite us, the engineer kicked open the pet cocks and started blowing the whistle. Imagining the thing had blown up, we tore out in all directions, some going under the house, some around it and the others to the adjacent woods, so the rest of the afternoon was spent by the old folks in rounding up the children.

My next connection with the road was when my father took a contract to supply one of the roads with wood. My brothers and I sawed and hauled the wood, and would usually manage to be on hand when the train came in. The train men were always glad to see us, and by telling us what smart boys we were, they generally got us to help them load up.

It was my intention then to work on the railroad as soon as possible, and at the age of 20 I was fortunate enough to get a job and have been continuously in service since. My

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first job was with a road that followed along the Yadkin river in North Carolina and, being constructed against the hill sides, it frequently suffered damage from the spring freshets that would get in behind it and turn it upside down against the telegraph poles. There was real work to be done in getting traffic restored, as a lack of equipment and proper tools made the job more difficult. Most of the work had to be accomplished by main force and awkwardness and for a time at least I was under the impression that the man who could make the most noise was the best railroader.

As well as I recollect, this line was laid with 40-lb. rail and the section foreman's equipment was confined mainly to a push car, a few shovels and bars, hammers, and a pry pole for raising low joints. The first jacks delivered to the foremen were a nine-days' wonder. Later there was much talk of the "big rail" and when it came it was 50-lb. steel. The roadbed was clay and during wet weather the track in the cuts would go out of sight. There was a standing argument between the foremen as to whether pine bark, pine straw or slabs from the adjacent sawmills were most effective under the joints. All of these and anything else that would hold a joint up were used until the track dried out. At the time I was made roadmaster the heaviest rail on our main lines was 70 lb. Ballast was not used until several years later. The only ballast we had was cinders and these were carefully conserved and used only in the cuts and other wet places. Strange as it may seem to the younger railroad men, we were able to maintain reasonably smooth track for a fairly fast schedule.

No Eight-Hour Day

There were no 16-hour laws or eight-hour days then. When a local freight started out, it kept going until it got back, which was sometimes 36 to 48 hours or more. In the roadway department the hours were "from daylight till dark and no grumbling." I well remember when the road on which I was working issued orders that the working day would be 10 hours. When our foreman read the order to us, as was required of him, he was so angry he could hardly talk. After reading the order, he said that if we were only going to work a part of the day "there sure was going to be a different move," and there was. Railroad jobs were in great demand then and the more men standing around the tool car looking for jobs, the harder the old man was to get along with. The only means of transportation for the roadmasters other than the train consisted of a crank car with a kind of coffee mill arrangement operated by two hand cranks. This was followed by a sawed-off lever car and afterwards by a velocipede.

The roadmaster's territory usually embraced a couple of hundred miles of line divided between main line and branches. His salary was smaller

than that of a present-day section foreman, and he had no expense account. The roadmaster, then as now, was supposed to be on hand at any and all times, for there were a great many wrecks and the equipment for cleaning them up was primitive. In fact, our first wrecking equipment consisted of a kind of gin-pole arrangement on a flat car with a cable, a few chains and some jacks. However, we managed to clear the line with them, although just how we did it I don't know.

It is a far cry from the materials and equipment of the old days to what we have now. Among the improvements are the use of ballast, heavier rail, the general use of machinery for all kinds of maintenance work, and more efficient methods. One of the greatest improvements has been in the personnel. In the old days railroad men were looked on as hard-boiled citizens. When a gang moved in, it was the custom to shut up the children and turn loose the dogs. However, all that has changed and the railroad men of today will compare favorably, man to man, in intelligence and good citizenship with any other class of men in the world.

I am glad to say that in our department there is no change in one respect at least. There is the same loyalty to the company's interest and the same bulldog grit and tenacity that in time of trouble and disaster keep the men on the job to the limit of physical endurance. There is no thought of comfort, food or sleep among the men at crucial times, for uppermost in their minds is the urge to get the line open and restore traffic. It is something that seems to get into their blood. I have often wondered if men in other occupations feel this same way.

If the true history of the building of the railroads and their maintenance and operation is ever written, it will record one of the greatest accomplishments in the known history of the world, and most of it right here in our own country and by the men from our own roads, many of whom went elsewhere to accomplish wonders in other countries of the world.

Fifty Years of Roadmasters' Conventions

By George E. Boyd

Associate Editor, Railway Engineering and Maintenance

A FEW years before this association was organized, some of the roadmasters of New England and Eastern Canada had founded what was known as the International Roadmasters' Association. This association had begun to attract a few men from the South and Middle West when it suddenly developed strong trade union tendencies, and interest in its affairs declined to the point where it finally disbanded about the time the Roadmasters' Association was organized.

However, owing to the utter confusion in maintenance practices, the progressive men in the maintenance field had recognized for some time the need of an organization through which maintenance officers would have an opportunity to meet and discuss their mutual problems, as well as gain social acquaintance with their fellows who were engaged in the same line of work. The time was ripe and it needed only a capable and aggressive leader to start the movement and carry it through to success.

George E. Boyd

Isaac Burnett

Such a man was found in Isaac Burnett, a roadmaster on the Chicago, Rock Island & Pacific, who worked untiringly in trying to interest maintenance officers in the idea of forming an association. He had joined the international organization, just mentioned, and had attended the convention in 1881. Disappointed to find little discussion of maintenance matters, but much enthusiasm for the union idea, he spoke very pointedly on the subject and announced his resignation.

Some weeks after this meeting Abel Kimball, general superintendent on the Rock Island, called him in, saying he understood that he, Burnett, was a member of the international organization and asked his opinion of it. After Burnett had told him, he drew from his desk a complete transcript of the meeting and commended Burnett for his stand. He then asked if there was not need for an organization of roadmasters whereby they could meet socially as well as professionally. Burnett replied that this had been his belief for some time, but that a strong leader would be needed and that much time and hard work would be required for the development of the idea. Kimball expressed the belief that he was the man for the job and encouraged him to undertake it.

Accordingly, he became active in interesting roadmasters of the various roads in the idea. After the preliminary work, a series of meetings was held at different points to arouse the necessary interest and give out information as to the purposes of the projected organization. The first of these preliminary meetings was held informally at Chicago in December, 1881, on a severely cold night. The last meeting preceding the meeting to organize was also held at Niagara Falls in the spring of 1883, with seven present, the names of five of whom are known. In addition to Burnett were J. H. Lindsley, Chicago, Burlington & Quincy, Charles Latimer, chief engineer, New York, Pennsylvania & Ohio, W. H. Courteney, Lake Shore & Michigan Southern and O. F. Jordan, Michigan Central, of spreader fame. At this meeting, plans were perfected for a general meeting to be held in the Matteson House at Chicago on June 13 and 14, 1883. A plan of procedure was worked out which will be mentioned later.

At the general meeting in June, at which 61 roadmasters representing 24 roads were present, Burnett acting as temporary chairman and John Tierney, Chicago, Rock Island & Pacific as secretary *pro tem.* As soon as the meeting was called to order the following resolution was offered and approved: "That we, the delegates present at this meeting, do form ourselves into an association to be known as the 'Roadmasters' Association of America.'" The meeting then proceeded to elect permanent officers to serve until the first convention, these

being Isaac Burnett, president; George C. McMichael, Louisville & Nashville, first vice-president; David Wright, Chicago, Milwaukee & St. Paul, second vice-president; John Tierney, secretary; Thomas Addison, Ohio & Mississippi, treasurer, and S. L. Sweeney, Wabash, St. Louis & Pacific, J. H. McDonald, Chicago, Burlington & Quincy and J. C. Evans, Wisconsin Central, as members of the Executive Committee. A constitution and a set of by-laws which had been prepared in advance were adopted by those in attendance.

These preliminaries were completed by noon and the afternoon was spent at the National Exposition of Railway Appliances which was held in Chicago from May 24 to June 23 of that year. Next morning the entire party visited the rail mill of the North Chicago Rolling Mill.

No review of the men who gave it such a splendid start would be complete without mention of Charles Latimer, an engineer of high attainments. He never became a member of the Association, but attended every convention to and including 1887, and was probably more influential in shaping its affairs and directing the procedure during the first five years than any other person except Isaac Burnett.

Latimer had been chief engineer of the Atlantic & Great Western and was chief engineer and later consulting engineer of the New York, Pennsylvania & Ohio (now part of the Erie), its successor. Finding himself greatly hampered by the confused maintenance conditions of the period he had formed a local association of the 12 roadmasters on his road, with a view to co-ordinating and improving their practices. Under his direction this small association did its work through committees, whose reports were thoroughly discussed at the meetings and conclusions adopted. It was largely a result of his experience and suggestion that the same plan was adopted by the Roadmasters' Association, which, as you all know, is still followed.

A Plan that Worked

In his speech accepting the presidency, Isaac Burnett announced that this method of working through committees would be followed. Committees were appointed to study and report at the first regular convention on drainage, cross-ties, rail joints, fastenings, nut locks and foot guards.

We should not overlook the fact that this association was a pioneer effort and that the men who organized it had no experience with association work, and that the bulk of the membership was totally ignorant of such matters. These men were individualists. Striking evidence of this can be found in the committee reports. Probably no committee was in complete accord with respect to its report, and only a few reports were presented without being accompanied by a minority report.

However, it should not be assumed that agreement on the part of the committee assured acceptance of the report. The members had well-defined opinions based on their individual experiences, which they were not afraid to express, often in picturesque language. While they were open to conviction, they were, to express it mildly, extremely conservative in the reception of new ideas.

What Came of It?

What has the Association accomplished, and has it measured up to the expectations of its founders? At the time of its organization fundamental changes were taking place in track construction and materials. Steel rails were slowly replacing the old iron rail. Angle bars were being substituted for fish plates. The old fibre washers were no longer adequate, even when iron clad. Nut locks were coming into use, but in most cases were not as satisfactory as the fibre washers. Wrought iron was still used in bolts. The split switch had been devised but a large number of roadmasters had not yet seen one. The cast iron frog would no longer stand up under the increasing wheel loads and speeds. These were only a few of the conditions that existed when the Roadmasters' Association was born. Others were as bad, or worse. Rail caused as much uneasiness at this time as any problem confronting the maintenance forces. The first steel rails approximated 50 lb., although there was a large mileage of lighter sections.

Recognizing their lack of technical training but having no other agency to study rail, these men courageously tackled the problem, and in 1887, the Committee on Rail brought in a report recommending the standardization of rail sections in a limited number of designs ranging from 60 to 100 lb. Realizing, however, that it was not equipped to carry the investigation further, the Association referred the whole matter to the American Society of Civil Engineers, as being the only society possessing sufficient scientific ability to carry the problem to a conclusion. Joints were tackled with equal energy, but like rail, all questions relating to design were finally referred to the A.S.C.E.

The substitution of "broken" for "square" joints can be traced directly to action by the Association. About 1890, a few 60-ft. rails were laid as an experiment, and later a considerable mileage of 45-ft. and 60-ft. had been laid, some with square and some with mitred joints. This fact was brought to the attention of the Association in 1897, in such a way as to raise the question whether either of these lengths should be recommended as standard. The Committee on Rail made a report in 1898, but the matter was referred back for further study. In 1899, however, the convention adopted a resolution recommending rails 33 ft. long with square ends, a length that was used universally until conditions were favorable for a still further increase to 39 ft. Switches and frogs, switch stands and all of the details of their construction were given intensive study and not a few of the developments of today can be traced to the intelligent and constructive study that the Association gave to these matters.

From the first, ties constituted one of the principal interests of the Association. It was natural, therefore, that it should also become interested in wood preservation. The Committee on Ties sifted the merits of more than 100 different preservatives and processes and, in 1890, reported its conclusion that "creosote is the only preservative that meets all of the requirements, including resistance to the teredo, of a wood preservative," but adding this word of caution, "but it is also the most expensive."

Track tools were discussed at every convention, but so many other matters pressed for solution that it was not until 1893 that the subject came before the Association in the form of a report. This committee also did its work well, bringing in a comprehensive report which, with one exception and a few minor amendments, was adopted. Indicating the importance of this action, some of these identical designs are in use today, and none of the others differ fundamentally from the designs now in common use.

When we come to the more recent history of the Association, we have some difficulty in evaluating the results of its activities, because the perspective is too violent. One action, however, stands out in bold relief. In 1922, a short but important report called attention to the possibility of increasing the length of sections, of confining section gangs to routine maintenance and of using specialized gangs to perform the larger maintenance operations. While this report aroused lively interest, there was no immediate reaction to the idea, perhaps because

it was entirely new, but the intervening years have seen one road after another adopt the fundamental principles that were outlined, modifying them only as necessary to meet the peculiar conditions on the individual roads.

In general, maintenance practices do not develop overnight, but through a process of slow evolution. For this reason, it may be a decade, or perhaps two or three, before one can say with certainty that a given practice originated with or was stimulated by the Association. At present, we are too close to these events to be able to evaluate them properly.

Obviously, the program today is different in character from those of the earlier day, because many of the problems of that day have been solved, and others have become highly specialized. Yet, the studies now being made are as important in the light of conditions as they exist today as those were with respect to the former conditions.

The Manufacturers' Contribution

By Robert L. Cairncross
Western Manager, National Lock Washer Company, Chicago

THIS Golden Anniversary convention revives a train of memories that remind us of the marvelous progress in maintenance through a process of evolution and a never ending research for materials and methods that will expedite the movements of transportation with greater economy and safety. Looking backward, we can well feel proud that we have participated in these progressive changes. We can also congratulate ourselves that we have lived in an age that has seen the most remarkable progress in every field that the world has ever known and which has brought with it greater opportunities for a fuller and more complete enjoyment of life.

All of you have co-operated heartily in the utilization of the many different devices which have been developed to improve the track structure, and some of you, through knowledge gained in practical experience, have invented devices that were subsequently manufactured by some railway supply concern, with resultant benefit to yourselves, the manufacturer and the railways.

This golden anniversary is of special interest to me because I entered railway service in 1885. I spent 25 years in this service in the West, and the next 25 years in the railway supply business. I have been associated with you in fighting blizzards and snow blockades and I know from experience the hardships encountered in the frigid climate of the North and in the extreme heat of the South, as well as those of the early construction days. I have seen the damage wrought by tornadoes in the middle western states. I have been with you in floods, washouts and derailments. In many of these cases the accommodations were wretched, the food poor and occasionally the water was unfit to drink. How we have lived through these hardships is one of the mysteries of life.

You have played a commendable part, and words fail me in attempting to express my admiration for your loyalty and fidelity in performing the laborious and oft times hazardous duties confronting you. This was to be expected, however, especially from you older men, for your fathers were the pioneers who opened the western country to civilization. You and others had in you that inborn sense of duty which has been such an important factor in making North America the great land it is today.

Robert L. Cairncross

Many Contrasts

There are many outstanding contrasts between the roads of 50 years ago and those of today. The first that comes to mind is the joint fastening, then commonly known as a fish plate, which looked like an ordinary flat bar bolted to the web of the rail. To apply a joint it was necessary to hold a wrench on the square head of the bolt, or to slip a lining bar under it, to keep the bolt from turning as the nut was tightened. This type of fastening afforded no anchorage and it was a problem to keep the rail from running down hill, especially on mountain grades ranging from one to four per cent. This form of splice was discarded for angle bars, more particularly to hold the rail from running than for the extra strength obtained. At this time bolts were devised that necessitated oblong holes in one bar, the nuts all being toward the outside of the track. Joints were not staggered in those days.

It will be interesting to contrast present-day methods of distributing ballast with those of 50 years ago. The ballast unloader looked like an elongated cow catcher, and had a five-inch longitudinal center groove in the bottom. To fit this groove, a four-inch by four-inch timber, protected at each end by a V-shaped metal nose, was bolted lengthwise of the flat car at its center. The plow was weighted with iron and rock to keep it in place, and before we started to plow, all brakes were set and blocks of wood were jammed under the wheels to prevent movement of the cars. If the unloading was being done on a curve, one or more blocks were chained to the outside stake pockets to keep the plow in line, yet on one occasion I remember, while plowing off on a sharp curve along Sycamous lake in British Columbia, these chains broke and the plow landed bottomside up in the lake.

Other materials and equipment were on a par with those that have been mentioned. Automatic air brakes were still in the experimental stage. Straight air was in use, but only on passenger equipment. With this form of braking, if a coupling parted the engineman could not set the brakes, even on the head end of his train, and obviously there was no automatic application in the rear section. The passenger cars had stoves at both ends, but sleeping cars were equipped with Baker heaters. Freight couplers were of the link-and-pin type and cars had brakes at one end only, and they were seldom maintained in good condition.

When automatic air began to be used on freight trains, we generally got only a few "air" cars in any train, and these were always switched next to the locomotive so that the automatic brakes could be used. Remem-

bering the amount of slack in the link-and-pin couplers, one can easily visualize what happened at the rear end of the train when the engineman applied the air. I have known cars to be derailed owing to a too forcible application of air.

In those days locomotives were not equipped with injectors or, in fact, with much of anything else. It was necessary to force the water into the boiler by means of a pump that operated only when the locomotive was in motion. It was nothing unusual, when flues were leaking badly and the water got low in the boiler after it had stood idle all night, for it to be necessary to run a locomotive up and down a siding, or even on the main line, for a time until enough water had been pumped into the boiler to make it safe to fire it up.

Fifty years ago it was no feat to sell materials to a railway. On the other hand, the problem that faced the railways was that of being assured of delivery. The reason for this was that the demand for materials exceeded the capacity for manufacturing them, owing to the rapidity with which new mileage was being constructed to open up the great western areas and to push through to the Pacific coast. At the same time, the established roads in the East were consolidating to establish through routes and were also building and extending branch lines to act as feeders.

Better Appliances

Following this period of easy sales there came an era of improved devices and other developments, bringing in its wake a change in marketing methods, including the high-pressure lavish-entertaining type of salesmanship, which was carried to such an extreme by Diamond Jim Brady and his imitators, most of whom have passed from the picture. They have been succeeded by supply men who have an intimate knowledge of the materials and devices they handle and who sell them on their merits.

During the past 25 years the railways have become progressively more particular about the quality and lasting characteristics of the materials they purchase. This has resulted in an effort on the part of progressive, manufacturers to improve their products. I am convinced that the improvement in quality, as well as the development of improved and new devices, have been largely responsible for the change in selling methods, which are now based on technical considerations. This is all right so far as it goes, but as practical men, you well know that the best criterion is service efficiency. I was reminded of this recently in a film, the leading character of which was Charlie Chan, the great Chinese detective. In explaining a mystery he quoted an old Chinese proverb which emphasized this point—"Theory is the mist on the glasses, which tends to obscure the facts."

In closing, I desire to pay tribute to my esteemed associates of the last 25 years, my fellow workers, the railway supply men. They are a wonderful group of men, and it has not only been a pleasure to have known so many of them intimately, but it has also been helpful in many ways. Competition during the depression has been keen, but through it all they have maintained a high morale and have continued to adhere to the unwritten ethics of business solicitation.

Ballasting and Resurfacing Track—

Equipment, Organization and Methods

Report of Committee

THE subject assigned to this committee is closely allied to others reported on to this association, notably those at the 1934 convention on Spot versus Group Renewal of Crossties, the Conservation of Rail and Methods of Cleaning Stone Ballast. In each of these reports, some items were discussed which relate also to the subject assigned to this committee. There are also many other factors which vary widely in themselves and in the combinations in which they are found on various railroads and on different portions of the same railroad. It is not possible, therefore, to develop definite formulae or rules governing this subject. Your committee can only discuss some of the more important principles developed by experience under various conditions.

J. J. Clutz
Chairman

When to Surface

Some factors of aid in determining the answer are: Rail condition; kind, condition and depth of ballast; tie renewals; speed, character and wheel loading of traffic; drainage and subsoil conditions; general condition of the track; and maintenance of way appropriations.

There can be no question but that new rail should be surfaced out of face immediately after it is laid. This includes a general raise, tie renewal and surfacing, and is necessary to prevent the rail from becoming line and surface bent. This is particularly important with the new and heavier rail sections with their greater relative web height. While such rail has more girder strength and does not deflect so readily over a loose or low tie, if this loose condition is allowed to continue the rail eventually becomes surface bent. When this happens, it is practically impossible to overcome the condition, whereas the older, lighter rail sections, with their lower web heights, were more flexible, deflecting under load over a loose tie, and not tending so greatly to take a permanent set. Even after such a set did develop, it could frequently be surfaced out.

If the rail is light for the traffic that it carries, it will require more frequent out-of-face surfacing to make the track ride well than rail of heavier section that has been well maintained and has not become surface bent. However, if heavy rail of relatively high web height is allowed to become surface bent, resurfacing will quickly break down and is usually not justified until the rail has been renewed.

The correction of a foul ballast

condition should be followed by resurfacing. Foul stone ballast is usually cleaned either in the shoulder, the intertrack space or the crib, or a combination of these areas. Any cleaning inevitably loosens the tamping under the ties, so that the track tends to become center-bound. This is particularly true of crib cleaning and of shoulder or inter-track cleaning on the high side of heavily superelevated curves. Cleaning is not practical in cinder or gravel ballast, and the track is either skeletonized and given a light lift on fresh ballast, or given a heavy lift to bury the dirt and then resurfaced on clean material.

If the depth of ballast under the tie is insufficient properly to distribute the tie load uniformly over the subgrade, the track surface will not hold up well and can be restored only by a general raise, which should be higher than is normally the case, to bring the ballast to the desired depth. If the ballast is not of the proper type to carry the tie loading, it will quickly break down and pulverize under traffic. In such case it should be replaced with a better type of ballast, usually stone, and the track given a sufficient lift to place several inches of the new material under the ties.

If tie renewals are heavy, the track should be resurfaced in connection with this work. Tie renewals are made much more economically if the track is given a lift. If a tie is dug in, the old tie is usually worn so thin by reason of plate cutting that it is necessary to destroy the bed in order to install a new and thicker tie. This creates track which will be rough until a new bed is formed. On the other hand, if the track is first raised, the old bed is not disturbed and a new and uniform bearing is obtained under all ties, both old and new, creating a resilient track.

At Least Four Ties

While there is no definite rule as to how heavy tie renewals must be in themselves to warrant resurfacing in connection therewith, 4 ties per 39 ft. rail are commonly used as the minimum in stone or gravel ballast. In cinder ballast, ties may be dug in so easily that tie renewals alone are usually not enough to warrant raising the track. With the widespread use of treated ties, annual tie renewals have been greatly reduced, frequently averaging one or less per rail length. In such cases, tie renewals of themselves do not justify resurfacing. This is one reason for a great decrease in resurfacing during the past few years. However, the very considerable tie renewals that have

This Surfacing Gang Is Using Pneumatic Tampers

been deferred during the depression, owing to severely curtailed maintenance appropriations, make it certain that heavy tie renewals will have to be made for several years in some locations. These should be made in connection with resurfacing, both to reduce the actual cost of installation and to improve the riding condition of the track.

Where speeds or wheel loadings are high, track which has once begun to break down in surface can be restored only by a general resurfacing. The increasing speeds of both passenger and freight trains demand smoother resilient track that is possible only through frequent resurfacing. Heavy freight traffic, particularly mineral freight, quickly fouls the ballast and resurfacing is necessary in connection with the cleaning of the ballast.

If surface drainage conditions are poor, the ballast fouls quickly and frequent cleaning and resurfacing are necessary. Narrow cuts, side ditches of insufficient depth, blocked cross drains, etc., are contributing factors. If the water table under the track structure is high, subgrade conditions are likely to be unstable, with the result that the track structure is constantly settling, requiring equally frequent resurfacing. If possible, it is best to effect a permanent cure through deep side ditches, perforated pipe or other drainage methods, to lower the water table. If sub-soil conditions are poor, a greater depth of ballast is required to maintain surface, because of the unequal settlement of the track. In some locations, clay from the subgrade works its way up through the ballast, requiring frequent renewal of the ballast and resurfacing of the track.

On the other hand, track may have good rail, ties and ballast, be well drained, and still not ride well because the ballast has so compacted under the ties that the track has lost its resiliency and rides "dead." In such cases, the only cure is resurfacing to restore the resiliency, although it may not be necessary to clean the ballast. Track which has become center-bound can be corrected only by resurfacing.

Last, but not least, maintenance of way appropriations affect the decisions as to when track should be surfaced. Much resurfacing has been postponed during the last few years because of lack of funds. However, rather than spreading the entire appropriation thin by undertaking only spot work, it is better to neglect some spots, carry others over with spot work and do out-of-face work on the worst stretches, where spot work is only thrown away. The decision as to what stretches of track should be resurfaced requires careful study and can only be determined on the ground, in the light of these and other factors.

Organization, Methods and Equipment

These are somewhat inter-dependent and are controlled by the kind of ballast, the height of lift, and the other work that is being done in connection with the resurfacing. In general, the height of the raise should be only enough to permit the placing of fresh ballast under the ties. Originally, track was usually raised high, to bury the dirty ballast and increase the depth of ballast under the tie, to insure uniform distribution of the load over the subgrade.

We have all heard of the old saying that "for every inch of raise, one back-surfacing is necessary." It is certain that the higher the track is raised, the more and the longer it will settle, as the new ballast compacts under the ties, and more surfacings will be necessary to preserve smooth, tight track. High raising also requires heavy ballast renewals, involving both the cost of the material and the work train distribution charges. On most roads work train charges are being scrutinized as it is felt that there is a possibility of substantial savings through the elimination of much of the work train service that was formerly thought necessary. As increased resiliency, improved tie drainage, the restoration of the surface, or the making of more economical tie renewals

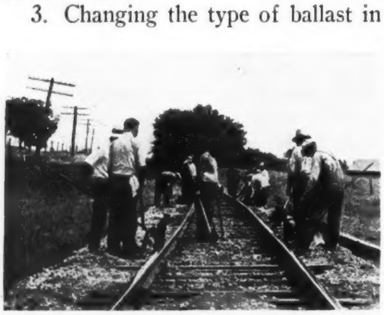
can be obtained, with a lift of not more than two inches, it is hard to justify a higher lift except when there is insufficient original ballast or special conditions prevail.

The three special conditions most commonly encountered that justify high raises are:

1. Changes in grade made necessary by some condition other than track maintenance proper, such as grade separations, correction of sags in the profile, raising to get the track above high water level, or increasing the depth of fine sub-ballast to prevent a soft subgrade material from working upward into the track proper. Such raises do not properly come within the scope of this committee report.

2. Insufficient depth of ballast under the tie to distribute the load over the subgrade uniformly. While there is some difference of opinion as to what is the proper depth of ballast under the tie; depending partly on subgrade conditions, the 1929 manual of the American Railway Engineering Association provides that on a roadbed material of clay, loam, etc., subject to deformation by the application of live load, the depth of ballast under the tie to produce approximately uniform pressure on the roadbed should be not less than the spacing center to center of the ties. Subballast is included in this depth up to one half of it. The A.R.E.A. manual further provides that on subgrade material that approximates the character of good sub-ballast (which will not be deformed by the application of live load), the minimum depth of ballast under the tie should be 12 in. Where this depth of ballast does not obtain, it is desirable to reach it as soon as possible, to insure that resurfacing will not break down quickly under traffic.

3. Changing the type of ballast in track. Usually this involves installing an improved material, but in recent years, owing to the falling off of traffic on some lines, it has involved the substitution of an inferior grade of ballast, such as cinder for stone ballast, which is adequate for the lighter traffic, cheaper in first cost, and more economical to work, requiring smaller gangs.



It Is Better to Do Out-of-Face Work on the Worst Stretches Rather Than to Spread the Work Over the Entire Territory

In changing the type of ballast, the track can be given a heavy lift on the new ballast, or it can be skeletonized and given a light lift. In either case, care should be taken to get several inches of the new ballast under the ties, both to insure the desired benefit from it, and to make it possible for the section gangs to work the track economically and efficiently, since different tools will probably be required for each type of ballast, and a mixture of two kinds can never be surfaced satisfactorily. Ordinarily it is more economical in labor, which is the heaviest item of expense, to give the track a heavy lift, both to bury the old ballast and to get the new ballast under the ties, unless such considerations as grade crossings or overhead clearances prohibit high raises.

Raises on Cinder Ballast

The resurfacing of cinder ballasted track is usually desirable when the cinder becomes pulverized and foul, holding water like a sponge. It is not possible to clean cinders and any light working of the track on pulverized cinder ballast is thrown away, for reballasting is necessary. If physical restrictions prohibit heavy raising, the track must be skeletonized and the worn-out cinders thrown along the side to widen the embankment, or hauled away. They should not be piled beside and just clear of the track, as they then block drainage and in areas with severe winters, the piles thus formed eventually act as a snow fence, causing the snow to be deposited on the track.

Skeletonizing is, however, expensive of labor. A heavy raise is more economical, burying the old cinders and placing enough fresh ballast under the ties to give drainage. This is ordinarily accomplished by first dragging the track full of fresh cinders, then raising it four to five inches, depending on the depth of the old ballast in the cribs, renewing the ties and giving the track a shovel tamp surfacing. In some cases where the speed and frequency of trains do not permit the making of the long run-off required for heavy lifts, two raises may be made. In such procedure, the first raise is just enough to bring the ties on top of the old ballast. The new ties are then installed, fresh cinders dragged and the track given a second lift to work the new ballast under the ties. A two or three-inch lift will usually bury the old cinders, and a one to two-inch lift for the second raise will work the fresh cinders under the ties.

Usually no special mechanical equipment is used in resurfacing cinder ballasted track, and there is little point to using a large gang. An organization of 16 to 20 men is quite sufficient, 12 of the men making the lift and tamping, while the balance install the ties and dress off the cinders. Ordinary square-pointed dirt shovels may be used for tamping, although tamping spades with blades almost flat and with a narrow foot rest along the top edge are more efficient. On such heavy lifts, ties can best be spaced with lining bars.

These Electric Tampers Are Fitted With Special Blades

Several mechanical tools have been developed for tamping cinder ballast. One type blows the cinders into position under the ties. Another type, very efficient, uses a blade vibrated electrically to work the cinders under the ties and compact them there, the electricity being furnished by a small portable motor generator set. However, such equipment is useful chiefly for spot-tamping joints, etc., on cinder-ballasted track. Except possibly in giving such track a very light resurfacing raise, without reballasting, mechanical equipment is hardly justified with a resurfacing gang.

Gravel and Stone Ballast

Gravel ballast is not adaptable to cleaning because the presence of the smaller particles is necessary to give some locking effect to the larger rounded stones. Gravel is not adapted to high lifts because of its inherent tendency to roll out from under the ties, due to the roundness of the pieces. It is, therefore, customary to dig foul gravel ballast out of the track and dispose of it, as with cinder ballast. Ties should be renewed and spaced at the time this skeletonizing is being done. The track should then be reballasted and given a surface raise of not more than two inches. Shovel tamping is ordinarily satisfactory. The organization and equipment referred to for cinder ballast

apply also to gravel ballasted track.

The use of stone ballast is growing, as it is, when considered from all angles, the most satisfactory and economical material for heavy traffic high speed tracks. It can be cleaned satisfactorily, as outlined in the report of your committee on Methods of Cleaning Stone Ballast that was presented at the 1934 convention. Between general resurfacings it requires the minimum of attention.

It was originally the practice to give stone-ballasted track a heavy lift of about four inches to bury the dirty ballast, the track then being completely reballasted. The track was fork or shovel-tamped, the ties being installed after the raise was made. With the perfection of mechanical methods of cleaning stone ballast, it is no longer necessary to bury the dirt. The inter-track and shoulder ballast and, if the maintenance appropriation permits, the crib ballast should be cleaned. The track is then given a two-inch lift and tamped with ballast forks or shovels. Ties are renewed and the track given a very light surface lift, the ties being pick or mechanically-tamped as desired.

Mechanical Tamping

The tendency today is toward mechanical tamping. Pneumatic and electric hammer-blow tamping equipment have been used with considerable success for some time. To date they have largely been powered by gasoline engine compressor or generator sets, which are somewhat cumbersome to move, flexibility being afforded by air pipe or electric cable extending up to 2,600 ft. from the power unit to the tampers.

Bulletin 372 of the American Railway Engineering Association for December, 1934, pages 354 to 374, inclusive, contains an excellent report and discussion on the organization and methods of raising track with gangs of 52 to 142 men. Four different sizes of gangs are discussed, each based on the maximum use of an 8, 12, 20 or 24 tool pneumatic tamping outfit, working in crushed stone ballast, with a lift of not more than three inches, and preferably less. This report goes into the subject so thoroughly that it is inadvisable to repeat it here.

In place of the semi-stationary power unit now generally in use and discussed in the A.R.E.A. report, crawler-mounted air compressors have recently been placed on the market. They eliminate the cumbersome pipe line, for the air is carried direct to the tampers through a hose, the machine operator moving the compressor along the track with the tampers. Thus the time required for moving the pipe line and the old power unit is eliminated, with considerable saving.

An even more recent development is a self-contained, gasoline-engine tamper unit, in which the downward stroke of the piston on the explosive cycle provides the tamping power to actuate the standard tamping bar, which is the same as that used in the more common pneumatic and electric tamper guns powered from a central motor generator set. These self-contained tampers are highly portable, weighing no more than some of the electric tamper guns, and are entirely self-contained except for a hot-shot battery attached by a short cable. To date they are giving very satisfactory service in spot-tamping work in stone ballast on at least one eastern road. While they are still in what might be called the test stage, insofar as field work goes, no serious trouble has been experienced and it is anticipated that they will be found to be practical for use in large extra gangs for tie tamping purposes.

Mechanical Tamping Units Are Now Used for Spot Tamping

On one road, where the traffic is very heavy, both as to density and axle loading, and the speeds high, track raising is, in general, being held down to one inch, or even less, tie renewals being carried out in connection with crib cleaning. The crib ballast is removed by hand, and is either piled in the inter-track space for cleaning by mechanical means, along with the inter-track ballast, or is cleaned by hand, using ballast forks, and returned to the cribs immediately. Where the crib ballast is very dirty and cemented, it is broken loose with light paving breakers, using 24 in. paving breaker points, which have been found to be faster and more economical than the traditional clay picks that hold their point for a very short time and are very exhausting physically to the user. The breakers are pneumatically operated, air being supplied by the compressor serving the pneumatic tie tampers.

The organization consists of a 20-man gang which cleans the crib ballast, installs ties, and pneumatically tamps the track thus cleaned and tied. The crib on one side of a tie which is marked for renewal is cleaned slightly deeper than the others and left open. A tie gang follows immediately behind the crib-cleaning gang, installing the ties the same day that the cribs are cleaned and filling in the cribs that had been left open. Ties which have slewed or bunched are respaced by the crib-cleaning gang.

Pneumatic or electric tampers give very satisfactory track on light lifts of an inch of less, with very little settling afterwards, and in many cases without requiring additional ballast, a factor of importance in a territory where it is difficult for work trains to secure the use of track for any length of time. With a low lift, the track is always ballasted sufficiently to prevent buckling in hot weather. Furthermore, the run-off is so short that it can always be provided without giving trains a slow order over the section of track being worked.

Respacing Ties

The tendency several years ago to respace ties uniformly throughout the length of the rail with respect to the joints, is being replaced today by that of doing as little spacing as possible, it being felt that respacing inevitably disturbs the tie bed, resulting in the track being rough, until the ballast is compacted under traffic and a new tie bed formed. The present tendency is to space the ties around the joints only insofar as may be necessary to insure that there is not more than the maximum desirable distance between bearing surfaces, usually 10 in., for the joint and shoulder ties. The other ties are spaced only when they are slewed or so bunched that pick tamping is difficult. Tie spacers are useful in light raises, but where the raise is sufficient to empty the crib, or where the track is being skeletonized, lining bars are faster.

In heavy lifts, where the use of the track can be secured and large gangs are used, power jacks facilitate the bringing of the track to grade. On such work some success has also been had with a power ballasting machine, which tamps the entire length on two ties on one side at a time. This compacts the ballast under the ties after a heavy lift, a final running surface being made after the heavy lift has settled for a few days.

In connection with resurfacing track, worn joint bars should be shimmed or replaced with oversize or

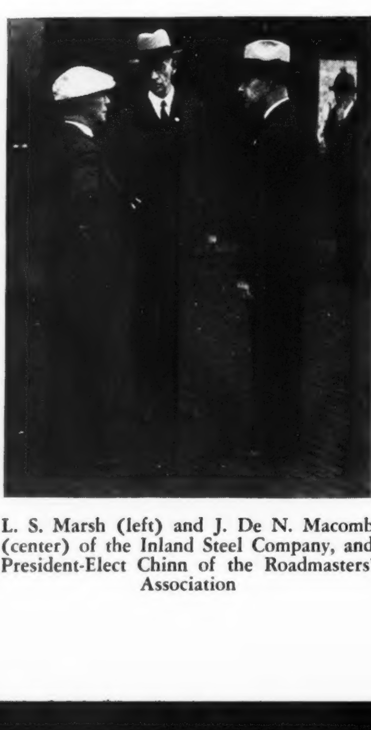
reformed bars. Battered rail ends should be welded or ground. Burned rails should be removed, or the burns should be ground out and a long run-off ground on either side, which the wheels will follow without causing impact. Loose or battered joints and burned rails will quickly ruin any resurfacing and they should be corrected beforehand.

On any resurfacing lift, no matter how light, a few loose ties will develop. To take care of them and to prevent their looseness from gradually spreading to adjoining ties, the track should be back-surfaced not more than a month after the original resurfacing is done. This can be done with a small gang, using tamping picks or a small portable power tamping outfit.

New ballast should be applied promptly to fill out any empty inter-track and shoulder spaces that have been robbed to fill in the cribs behind the resurfacing. If this is not done, the tamping may work loose and the line deteriorate. Care should be taken in unloading the ballast, to see that no more is put off than is necessary, for surplus ballast must be handled by hand and with crushed stone, that is a slow, tedious process. Ballast should be placed where it is needed. To that end it should either be loaded in special cars, permitting unloading on either side, or, if loaded in standard hopper cars, ballast "pans" should be used, which permit unloading on either side or in the center.

In one very heavy traffic, high speed territory good results are being obtained by working over the track with a four-tool electric tamping outfit between periodic resurfacing. An attempt is being made to go over the tracks annually with the four-tool outfit, operated by 6 trackmen under an assistant foreman, who are carried on the payroll of the foreman on whose section they are working. No out-of-face lift is made, but irregular cross level and surface are corrected and all ties are tightened. In many cases no jack is used, the power tampers bringing the ties up tight and correcting irregularities of 1/8 in. The time between out-of-face resurfacings is thus increased and considerably better riding conditions maintained.

In making general raises of two inches or more, the top of rail profile should be run and grade stakes set by the engineers in order to insure a good profile on the finished job.



L. S. Marsh (left) and J. De N. Macomb (center) of the Inland Steel Company, and President-Elect Chinn of the Roadmasters' Association

Conclusions

1. Many factors enter into the question as to when to raise track, which can be decided only by the man on the ground after taking all these factors into account.
2. Foul ballast should be cleaned or disposed of before raising track.
3. Worn joint bars, battered rail ends and burned rails should be corrected before resurfacing.
4. Where tie renewals reach four or more to the rail, surfacing out-of-face should be considered.
5. Unless special conditions dictate otherwise, the raise should not exceed 3 in. and preferably not more than 2 in.
6. Stone-ballasted track should be tamped mechanically in resurfacing.
7. The resurfaced track should be back-surfaced after a month to correct any loose ties which have developed.

Committee: J. J. Clutz (chairman), supervisor, Penna., Trenton, N.J.; P. J. McAndrews, roadmaster, C. & N.W., Sterling, Ill.; J. A. Spurlock, roadmaster, M-K-T., Franklin, Mo.; E. L. Potarf, district engineer maintenance of way, C.B. & Q., Omaha, Neb.; H. S. Talman, supervisor, C. & O., Thurmond, W. Va.; J. H. Dunn, roadmaster, N.Y.C. & St. L., Fort Wayne, Ind.; G. L. Sitton, chief engineer maintenance of way, Southern, Charlotte, N.C.; A. G. Reese, roadmaster, C.B. & Q., Trinidad, Colo.; G. E. Kessler, roadmaster, S.P., Richland, Tex.; G. B. Hickok, roadmaster, A.T. & S.F., Lubbock, Tex.; C. A. Geiger, supervisor, N.Y.C., Columbus, Ohio; L. J. Drumeller, division engineer, C. & O., Hinton, W.Va., and E. E. Crowley, roadmaster, D. & H., Oneonta, N.Y.

Discussion

Referring to that portion of the report which recommends the closer spacing of the ties at the joints, than elsewhere, F. B. Lafleur (S. P.) pointed out that all roads do not use slotted angle bars at the joints. Mr. Clutz replied that it is a common practice on some roads to require a closer spacing of the joint ties in order to provide a better bearing for the joints. E. L. Banion (A. T. & S. F.) said that the practice on his road was to space all ties evenly and to depend on the use of a sufficient number of rail anchors to retard the creeping of the rails. Mr. Clutz remarked that on his road no attempt was made to obtain either suspended or supported joints, but that a closer spacing of the joint ties as compared with the intermediate ties was obtained in order to provide a stronger bearing for the joints.

W. H. Sparks (C. & O.) said that on his road the tendency in recent years has been to avoid any effort to space ties at the joints and that during the last year a uniform spacing of 21 in. center to center of the ties has been adopted. R. Yost (A. T. & S. F.) said that with the use of 24-in. sheared angle bars, a sufficient number of rail anchors, and with a tie spacing center to center of 19 1/4 in., no trouble has been experienced with the skewing of joint ties. Mr. Banion pointed out that another advantage of this system was that it eliminated some wear of the joint ties.

Referring to the statement in the report that the ballast should have resiliency, A. Chinn (Alton) asked the committee what its attitude was toward the experimental concrete roadbed of the Pere Marquette and to the GEO track construction that has been installed experimentally on a number of other roads. In reply, Mr. Clutz said that the committee had no information concerning the concrete roadbed and that the GEO track had not been in service a sufficient length of time to permit the formation of an authoritative opinion.

Practice on the A. C. L.

B. E. Haley (A.C.L.) pointed out that it was the practice on his road to use both slotted rail joints and anti-creepers, and that the joints are slot-spiked everywhere except at crossings and in station yards. In giving his opinion concerning the building up of rail ends by welding, Mr. Haley said that as a preliminary to this work all joints should be tamped and the angle bars changed out or tightened. It is his practice to use built-up bars as against reformed bars, the bars being pre-heated before being built up.

Mr. Chinn said that in his opinion the slot spiking of joints was an undesirable practice. He cited an instance where new rail was laid in track that had been raised on chatts the previous year, the joints in the new rail being slot-spiked. Within

two weeks, he said, the joints that had been slot-spiked were easily discernable from the rear end of a train because of the movement of the joint ties that had taken place. He cited also the case of a switching lead where it had been the practice to slot-spike the joints. It was necessary, he said, to pick up this lead once every two or three weeks. In replacing this lead with second-hand rail, the ties were spaced evenly and the joints were not slot spiked. Six months later the track was still in good condition although no work had been done on it.

Mr. Banion asked if the committee had any figures showing the cost of cleaning ballast as compared with the application of new ballast. Mr. Clutz replied that it was a generally accepted fact that it is cheaper to clean stone ballast than to replace it with new ballast. In this connection, he said, the cost of unloading the new ballast and of raising the track must be considered in determining the total cost.

Recent Developments in the Organization of Track Forces

Report of Committee

INFORMATION received from more than 50 railroads in the United States and Canada shows that the form of organization of track forces in effect on these different railroads varies as widely as the earnings of these roads have during the last few years. A few lines have been so fortunate as to find it unnecessary to make much reduction in their maintenance allowances and still have about the same organizations as existed prior to 1929, but a large majority of the roads have been forced by decreased earnings to make drastic reductions.

This reduction has been effected mostly by extending the territories of the roadmasters or supervisors and lengthening sections. The length of main line sections has been increased 25 to 50 percent, and in a few cases even more, while most branch line sections have been extended as much as 100 percent. On most railroads branch line sections now average about 20 miles in length. On these roads the same organization is in effect that has been followed for a number of years past, but the number of employes has been greatly reduced. The savings have resulted from reducing the number of roadmasters, supervisors and foremen without, in most cases, making any increase in the number of laborers in the gangs.

W. C. Pruett
Chairman

Changes in Organization

A few railroads have recently made some changes in the basic organization of their track forces. The most radical change is that made by one railroad, on which it is the practice to overhaul main line tracks completely about every four years. On this road all section forces have been eliminated and extra gangs created in their place. This has relieved the foremen of responsibility for any particular territory. Headquarters are established for each extra gang at the most convenient location. Regardless of headquarters, a gang is assigned to any point on the sub-division where work is most required.

It is thought that this has brought about economies due to the improvement in efficiency resulting from specialized gangs performing the same type of work day after day. Although the extra gang foreman is relieved of responsibility for a fixed territory, he is assigned specific locations, nearest his headquarters, to protect during severe storms and is held accountable for such protection, and is required to repair any unsafe condition that he observes or that is called to his attention. These extra gangs are of two types: (a) large gangs of 20 to 24 men, with an assistant foreman to handle power machines in the overhauling of tracks; and (b) smaller gangs of 10 to 12 men without an assistant foreman to take care of the many smaller jobs where large gangs would be wasteful.

With the elimination of track walkers, track patrols were created which, in addition to taking care of minor defects formerly repaired by the track walkers, are responsible for the proper inspection of tracks, roadbed and right-of-way on their respective territories. Their territories are such that they can be covered once a day in each direction, alternating on different tracks of a multiple track line. They make a daily report to the supervisor, showing the hours worked and reporting any defects or unusual conditions noticed during the day.

One large railroad of the middle west has recently reduced the number of sections from 1702 to 968, which increased the average length of main-line sections from about 8 to 12 miles and on branch lines from an average of 12 miles to 30 miles and in a few cases more. Without reducing the number of laborers, the smaller number of sections permitted the assigning of a larger number of men to each gang.

Along with this lengthening of the sections, new positions were created which are termed track supervisors. The men appointed to these jobs have the responsibility of patrolling about 75 miles of principal main line, making the patrol one way each working day or three round trips each week. On these patrols they make the same type of inspection that was formerly required of the section foreman. The track supervisor has authority over the section foremen on his territory, being in effect, an assistant roadmaster.

By these inspections each day he is in a position to direct the foremen where to work; also he relieves the foremen of their daily inspections, with the resulting loss of time to their section gangs. It is reported that this reorganization has markedly increased the amount of work done by each gang.

Another railroad has increased its section lengths about 100 percent on a part of its line and has created the positions of track inspectors, with territories of sufficient length to permit daily inspection from motor cars. These track inspectors relieve the foremen of detail inspection trips.

Still another railroad has installed a track master system, with the duties of these track masters similar to those of the track inspectors mentioned above. The advantages of these systems have been the saving resulting from the elimination of foremen by the lengthening of sections; and the relieving of the remaining foremen of the duty of detail inspection, thus allowing them more hours for constructive work.

On most of the railroads of this country the forced reductions, due to decreased earnings, during the past few years, have been accomplished by lengthening supervisors and roadmasters' territories and lengthening the sections, with a resulting decrease in the number of employes. A few railroads have effected these savings by retaining the same organization but working only part time.

These savings in maintenance of way expenditures were made possible by the fact that the railroads had been built up to a high standard of maintenance by an average annual expenditure of more than $800,000,000 for upkeep during the seven years prior to 1929. This money was spent mostly for heavy rail, improved rail fastenings, roadbed widening and drainage improvement also for improved methods of surfacing with good ballast. These expenditures made possible the low expenditure of $322,286,218 for maintenance in 1933. Then too, during the last five years there has been a wise concentration of labor and material on the track structure itself, largely to the neglect of the right-of-way, ditches, fences, and other less important items.

The last few years of severely restricted maintenance allowances have taught us many lessons in the economical handling of labor and materials. But it is to be hoped that the necessary practice of doing only the most essential work will not become such a habit as to cause permanent neglect of the many refinements that go to produce good track maintenance.

Must Prepare for High Speeds

In the past we have built and maintained tracks for a usual maximum speed of 60 miles per hour. There is no doubt but that in the future we shall be required to build and maintain tracks for speeds of 100 miles per hour or more. Also in the years just prior to 1929 a maintenance of way ratio of 15 to 18 percent of the gross earnings was considered good for the average railway, while in the future we will no doubt be expected to do a good job with 10 to 12 percent. With a more stable roadbed, heavier rail and better rail fastenings, treated ties, a better ballast section, greatly improved drainage, the use of the many mechanical devices that are now available, and the welding of rail ends and switch parts, we feel that we can meet these demands, but to accomplish satisfactory results it may be necessary to make some changes in the organization of track forces.

A majority of the railroad officers from whom this committee has received information have expressed their desire to retain the old organization of section gangs supervised by section foremen. Section gangs should continue to be the backbone of the maintenance of way organization, because there are so many maintenance of way tasks, such as the repair of fences, the adjustment of switches or guard rails, the replacing of broken bolts or angle bars, the renewals, gaging, and cross level work and unexpected or emergency work, that can be done more economically by small section gangs than by larger floating gangs or extra gangs. Then, too, it is the general opinion that best results are obtained by a smaller all-year section gang under a foreman with continued interest in and responsibility for the maintenance of a definitely assigned territory.

Sections Have Been Greatly Lengthened on Many Roads

Section limits may be extended considerably as compared with the short sections that were the practice prior to 1929, particularly on railroads with motor cars, but in no case should the sections be of such length as to make the patrolling of the track or the going to and from work too expensive.

For greatest efficiency, the section limits should be proportioned throughout each division on an equated mileage basis. A table of values derived from actual costs, extending over a period of years on one railroad, which was a subject of special study by a committee of the American Railway Engineering Association, was given in a report on the Programming of Section Work in the proceedings of that association for 1925. We are of the opinion that these values have not changed materially during the last ten years and for convenience, the table is repeated here.

One mile of first main track is equivalent to:

1.15 miles of second main track.
1.33 miles of third or fourth main track.
2.00 miles of branch line track.
2.00 miles of passing or thoroughfare track.
3.33 miles of yard tracks.
12 main line switches.
20 side track switches.
10 railroad crossings.
12 city street crossings.
25 to 50 country road crossings.
½ mile of track pans.
4 miles of ditches.

It is suggested that a section of 12 to 15 equated miles is sufficiently long. If the length of sections throughout a division, or preferably the entire system, is arranged on an equated mileage basis, it will then be possible to assign an equal amount of labor to each section. Of course, the number of men alloted to each section will depend upon how much money the management feels it is able to provide from the earnings, because, notwithstanding the fact that only about 35 percent of the maintenance expenditures are affected by use, the track maintenance program is now and always has been based almost entirely on a proportion of the earnings, generally known as the maintenance ratio.

Bolt Tightening Is Being Done Out-of-Face With Mechanical Equipment

For the greatest efficiency in the small section gangs, it is suggested that they consist of a foreman and an odd number of men, say 3 or 5 men, so that the foreman will have a man for a partner, and will be a working foreman. This is the practice followed on most railroads at present.

It is agreed that the roadway requirements are measured by the amount and kind of use made of the roadway, such as the density of traffic, the weight of equipment and the speed of trains. In order to attain the standard of maintenance desired by the management there should be provided, in addition to the small section gangs, at least one, or more, extra gangs for each roadmaster's subdivision as may be needed to do the work required. To provide for most efficient work, with resulting econ-

omy, each extra gang should be furnished with power machines manned by men specially trained for handling them and should be in charge of the best available foreman, with an assistant foreman if needed.

The size of these extra gangs will depend entirely upon the work assigned to them. For instance, a bolt-tightening gang may consist of only one, or better two, machines handled by two men, who will be assisted by each section gang on its respective section. The larger gangs should complete all of the rail laying, ballasting, construction jobs, and even heavy tie renewals where required, without interfering with the routine work of the section gangs.

With the track structure consisting of a well-settled roadbed, with good drainage, heavy rail, improved tie plates and rail fastenings on treated ties, and a good ballast section, supplemented with the use of rail flaw detector cars and rail end welding, it will be possible to effect substantial savings in maintenance expenditures in the future by obtaining longer serv-

Track Inspectors Relieve Foremen of Track Patroling

ice life from materials, and there will be less need in the future for the type of inspections formerly required of track walkers and section foremen. But, with the longer life of materials, particularly rail, and the demand for refinements in maintenance to permit higher speeds with safety there will be need for more efficient inspection by especially trained and qualified men. This can be accomplished by the assignment of roadmasters or supervisors to territories of such lengths as to permit them to make the necessary detailed inspections, or, as is now the practice on a few railroads, by track masters or track inspectors with territories 50 to 75 miles long, depending on the maintenance requirements. Where the positions of track masters or track inspectors are created on heavy traffic lines, and particularly on multiple track divisions, best results can possibly be had by assigning them to territories short enough to permit them to make a round trip each work day. In fact, it is possible that the only territories where such positions are justified are on divisions with extra heavy traffic and multiple tracks.

The Preferred Organization

The information at hand indicates that the maintenance representatives of most railroads recommend an organization of track forces about as follows: On single track lines with heavy traffic and even on most double track lines a roadmaster or supervisor's territory should consist of about 100 miles of line, or a train operating division, with possibly one terminal, and on lesser lines a maximum territory of 150 miles. Each division should be divided into sections of 12 to 15 equated miles and these sections manned by a foreman and 3 or 5 laborers. To supplement the work of the small section gangs, each division should be allowed one or more extra gangs as may be needed to meet the standard of maintenance required. These extra gangs should be furnished with desirable power machines and manned by the most efficient foremen that are available and specially trained men.

It is the opinion, too, that no single factor has a greater influence on efficiency in maintenance of way work than that of programming it in such a manner that it can be carried on systematically. Extra gangs may be increased or decreased in accordance with the demands of the working season, but the work planned on each section's program should be so arranged as to employ as nearly uni-

Tie Renewals Are Being Made by Extra Gangs on Some Roads

form a section force as possible the year round. Steady employment attracts a better class of labor, and will result in more efficiency.

To provide an incentive for better work, it has been suggested that consideration be given to providing a differential in the rate of pay for trackmen in accordance with their experience and efficiency. For best results, with power machines, it is essential that specially trained operators be given a higher rate of pay. Atten-

Track Inspectors Equipped with Motor Cars Are Now Employed on Several Roads

tion is called to the successful practice of one eastern railroad which for some years has been operating under a system of stabilized forces where foremen and assistant foremen receive a monthly salary covering all time worked, and for exceptionally good work and overtime may be recommended for a bonus. Trackmen start at the basic rate and advance to the maximum rate after a certain period of service.

We would mention one more consideration in the efficient organization of track forces for the future—the education of foremen and trackmen. This is a subject that has long been before maintenance supervisors; with the advent of power machines and specialized gangs, it will be even more important than before. Roadmasters should instruct their foremen thoroughly in the selection of new men for the organization.

They should be selected with the thought that they will continue in the organization and become skilled trackmen, machine operators and even foremen. One of the principal assets of a roadmaster's organization is a good supply of capable men from which to fill vacancies in the ranks of foremen, or to fit in with specialized gangs as they are needed.

The committee feels that, with the advent of streamlined trains and the certainty of higher speeds in both passenger and freight service to meet other forms of competition and the demands of the public, there will be a continuous demand for maintenance men to design and maintain a better and more permanent track structure; and that it will also be necessary to change the organization of track forces from time to time, to adapt it more closely to the use of power machines and specialized gangs.

Committee: W. C. Pruett (chairman), general foreman maintenance of way department, M-K-T, Muskogee, Okla.; C. F. Allen, roadmaster, C.M.St.P. & P., Milwaukee, Wis.; B. M. Bennett, supervisor, Wabash, Owosso, Mich.; E. D. Bentz, roadmaster, C. & N. W., Fremont, Neb.; H. R. Clarke, engineer maintenance of way, C.B.

& Q., Chicago; W. T. Eldridge, supervisor, Y. & M.V., Baton Rouge, La.; W. H. Haggerty, supervisor, N.Y.N.H. & H., Harlem River, N.Y.; J. B. Kelly, general roadmaster, M.St.P. & S.S.M., Minneapolis, Minn.; H. E. Kirby, cost engineer, C. & O., Richmond, Va.; F. J. Liston, roadmaster, C.P.R., Montreal, Que.; F. J. Meyer, assistant engineer, N.Y.O. & W., Middletown, N.Y.; H. W. Stetson, general supv., M. C., Portland, Me.; and R. J. Yost, roadmaster, A.T. & S.F., Chillicothe, Ill.

Discussion

In opening the discussion of this report E. E. Crowley (D. & H.) questioned the thoroughness of an inspection made by a man riding on a motor car, particularly when he covers as much as 75 miles of track per day, and has to look out for trains, since he is alone on the car. Supplementing this thought, O. Surprenant (D. & H.) declared that a man should not be allowed to ride a motor car alone.

In response, M. Donahoe (Alton), while admitting that a man cannot make a thorough inspection of 75 miles in one day, stated that he can inspect part of his territory thoroughly each day and that as these inspectors are generally required to tend switch lamps, they can readily inspect the switches at the same time. In his opinion, 75 miles of single track is the maximum territory that should be assigned to one man and on double track it should not exceed 50 miles. In answer to a question from T. Thompson (A.T. & S.F.), he said that the inspectors necessarily ride trains on days when storms prevent the use of the motor car. He contended that an inspector is necessary to avoid excessive loss of time of section gangs in covering the longer sections.

Elmer T. Howson *(Railway Engineering and Maintenance)* complimented the association on the thorough discussion of this subject, pointing out that discussions of this kind are of unquestioned value to those present and to the railroads they represent, since it is only through such discussion that the facts relating to new developments can be clearly set forth. In his opinion, the differences in opinion expressed arise from differences of viewpoint—not all men have the same idea as to what the typical railroad implies. The average railroad, he said, is not a multiple-track line with 20 or more trains per day, but more nearly a single-track line with 5 to 8 trains. The track inspector system, he explained, is simply one of many expedients that the railroads are now trying out in an effort to meet the changing conditions imposed in maintaining the railroads, specifically in this case, to reduce the relative expenditure for supervision.

A. Chinn (Alton) explained that his road is now making a test of the track inspector organization on two territories, one a secondary main line 75 miles long and another a double track section of 50 miles, but that this test has not been carried far enough to warrant definite conclusions. He agreed that the employment of a track walker insures the most thorough inspection, but contended that it is important not to overlook the advances made in maintenance practices, in track construction and in the protection afforded by automatic signals in reducing the need for the detailed inspections formerly made. In addition, he said, it is necessary to consider the demand for greater economy.

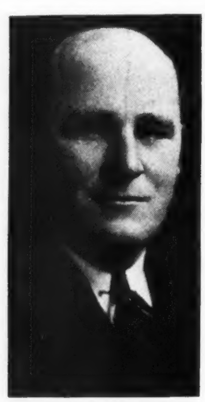
G. B. Hickok (A.T. & S.F.) reported good results with a track inspector on 100 miles of line over a period of five years. J. P. Corcoran (Alton) described a plan applied to 50 miles of double track, where the inspector made a detailed examination of the switches at three different stations each day, thereby insuring a careful and thorough inspection of all the switches every week.

The Maintenance of Tracks in Terminals—

Organization, Materials and Methods

Report of Committee

LARGE terminals, with their attendant congestion, complicated switch layouts, constant changes in switches and privately-owned trackage present many problems to the roadmaster that differ widely from those confronting trackmen on line territories. It is not surprising therefore, that widely differing practices are found on various roads. Furthermore, certain trends in recent years indicate that the old order is changing.



A. H. Peterson
Chairman

Fewer Terminal Gangs

In the same manner that the section gang of twenty years ago is rapidly changing into a larger unit embracing within its jurisdiction two, three or more of the old time section territories, most of the railways are reducing the number of their terminal gangs. In their stead are coming a few larger units, each under the supervision of a general foreman. Since 1924 the number of terminal gangs has gradually decreased on most railroads. The number of section gangs in terminals decreased 26 percent from 1924 to 1934 while the territory per gang increased 12 percent. Timekeepers and assistant foremen were the rule on most terminal gangs ten years ago while today there are practically no timekeepers on these gangs and assistant foremen are rare. These changes have been brought about largely by the necessity for retrenchment by the carriers to offset decreased earnings.

Those roads which have increased their foremen's territories to the extent that one foreman maintains 50 miles or more of track and 200 to 300 switches, have provided those foremen with an assistant known as an assistant general foreman. Such a gang is directed by a general foreman who plans and directs the work, hires the men, makes out the reports, and is responsible for the condition of the track in his territory, while the assistant follows out the orders of the general foreman and ordinarily is directly in charge of the work, the general foreman being absent part of the time making inspections of rail, ties, etc. Each of these gangs is ordinarily

provided with a track walker who patrols leads and other yard tracks and does light repair work single handed. With this type of organization it is customary to assign a few men permanently as lamp tenders, one man ordinarily being able to care for 300 switch lamps and also do some oiling of switches. Other men may be assigned permanently to the icing or cleaning of cars, janitor work, etc. By delegating such duties to certain assigned men who will follow a regular routine, fewer men are required to do the same work and the rest of the gang is not disturbed.

The Track Inspector

The last member of a large gang terminal organization to be discussed is the main line track inspector. He is provided with a helper and a light inspection car and makes a daily patrol of all main line tracks. He carries a gage, a level, a maul, a wrench, and the usual flagging equipment. This man examines all main line switches minutely and notifies the general foreman in writing when any work is necessary. Copies of such notices are always given to the roadmaster. The track inspector should be the best man obtainable, chosen for his knowledge of track and his general trustworthiness.

Some railroads employ a crossing gang during the summer months to install and repair grade crossings. Others prefer to do crossing work with bridge and building department men, doubtless feeling that the ordinary track man makes a poor carpenter, or governed perhaps by working agreements. However, when a crossing is undergoing repair there are usually ties or rail to be changed or refinements of line and surface to be made which must be done by trackmen and if the trackmen are not present the crossing goes in over a poor track structure. For this reason it would seem that a gang properly educated in the installation of bituminous, plank, steel or slab crossings and having a proper knowledge of track work in addition is the solution. Such a gang is able to perform any work necessary on a highway crossing. A few roads contract all terminal crossing work at a fixed price per square foot. Railroads which are still operating under the small section gang organization ordinarily install new crossings with bridge and building forces while the section force maintains them.

In the larger aspect of terminal track organization it is found that each terminal gang usually maintains main line as well as yard tracks. It is the opinion of the majority of the committee that a separate main track gang is desirable, for this will permit the yard foremen to confine their attention to yard tracks and leads while the main line receives the undivided attention of a separate gang. Main tracks are laid with better rail and better ballast and should be worked over from time to time to keep them in good condition. With several hundred yard switches and tracks with every conceivable rail section, the yard foreman is often so pressed for time that, knowing his main line is in comparatively good shape, he neglects minor corrections in it in order to work on a heavy switching lead or a poorly maintained yard track. Furthermore, yard foremen do not always make the best main line foreman while conversely an efficient main line foreman may not be so successful if transferred to a yard.

Where Foremen Come From

As a rule, a general yard foreman has had extra or large-gang experience. In some instances he has been promoted from the ranks of laborer while in other cases seniority has been the principal factor. Men with extra gang experience have a broader perspective, are accustomed to handling large gangs of men and are able to plan their work better when given a large territory to maintain.

Few railroads maintain special snow-handling organizations, contenting themselves with their regular gangs, augumented with outside labor as the need arises. Temporary foremen are appointed from among the best regular laborers, except in extreme storms when it is sometimes necessary to transfer foremen from other points to meet the emergency. One Chicago road has made it a practice for many years to divide its terminal trackage into zones, with key men listed for each interlocking plant and other important locations. These men, who are regular employees, are chosen for their familiarity with the locations to which they are assigned and their ability to handle inexperienced men during stormy conditions. A list or chart is prepared at the start of the winter season, copies of which are distributed to each general foreman, who posts it at his headquarters. This chart contains the telephone numbers and home addresses of all employees concerned, lists the numbers of all engines equipped with snow flangers, the points at which reserve snow tools and salt are kept and such other information as is deemed desirable. With such a system, each man who works regularly knows immediately where to report in case of a heavy snow fall. During a storm, the general foreman maintains a check of his territory by telephone and on foot and also calls the roadmaster's office hourly to advise him of the need for men, food and supplies. Most of the larger terminals are further equipped to some extént with oil, gas or electric snow melters, steam coils, etc. Heavy and drifting snow may paralyze a terminal quickly unless every precaution is taken and plans laid well in advance.

Have We Gone Too Far?

The present terminal organizations are largely an outgrowth of the older gangs. Men are able to accomplish more with the addition of machinery and labor saving devices, more efficient supervision, and better materials of all kinds. The cost of terminal maintenance is now the lowest in history while the derailments are the fewest. With a smaller number of gangs, less material need be carried in stock and the properties are maintained today with minimum overhead. Each gang is capable of handling its own material without doubling up. In the opinion of a minority of the committee some roads have gone to extremes in the concentration of yard track mileage under a relatively few foremen but all members of the committee are in agreement that we had too many foremen in the past and that the present system is more satisfactory.

Obviously a section gang in one of our larger terminals cannot hope to work over all of its tracks each season. Rather, it is expedient to work over a portion of the tracks each year, making heavy tie renewals and renewing rail out-of-face so that these tracks will require little attention for some years to come. Meantime repairs on other tracks are held to the minimum necessary for safety until such time as they become a part of the season's program for general overhauling. Switching leads, yard running tracks, engine lots, hump tracks, and tracks of similar importance must of course receive continual attention.

Terminal section gangs are not ordinarily required to do heavy out-of-face rail or ballast work. Such work is generally done by extra gangs, the local gangs confining their attention principally to maintenance work. While a few roads do all of the track work in their terminals with their regular section gangs, it is gradually becoming the practice to employ one or more floating gangs to do the heavier work of out-of-face rail laying, surfacing, and tie renewal. Specializa-

tion is the order of the day in terminal railway practice. A man who uses the same tool daily becomes adapt at his particular job, whether he be a spiker in a track gang or a mechanic in an automobile factory. One of our middle western roads has, within three years, reduced the cost of laying rail from 12 cents a foot to less than 3½ cents by means of specialized rail gangs. Comparable reductions have also been made in the cost of surfacing and of tie renewals. A terminal floating gang relieves the section gangs of the heavier work and enables the general foremen to keep up with the maintenance of their tracks from day to day.

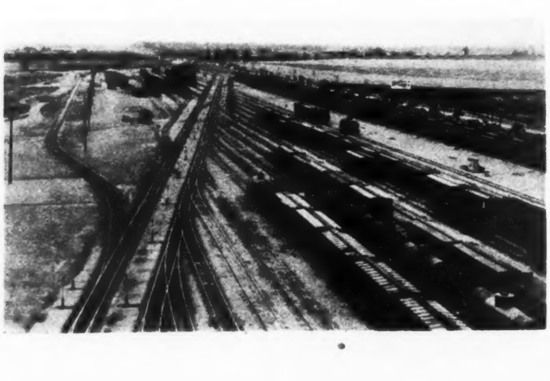
A terminal section gang is called upon continually to perform extraneous jobs on short notice. It does everything from the laying of sewer pipe to the washing of cars. With much of the rail in our terminal yards of light section and old rolling, it is a full-time task for a terminal general foreman to keep pace with broken rails and other emergency work. Then there are the problems of repairing switches that have been run through, gage to correct, weeds to mow, switches to oil, and a multitude of other tasks, which makes it difficult for a terminal foreman to find time to do out-of-face work.

In time of heavy business it handicaps trainmasters and yardmasters to give up important tracks or leads for more than a short space of time. A floating gang that is able to work without interruption, can release such tracks more quickly; it is also able to do such work at a lower cost. A floating gang may be of practically any size, providing it is possible to obtain sufficient trackage upon which it may operate. Usually a gang of from 50 to 75 men is found most satisfactory in the yard while a gang of 20 to 30 men may be more suitable on leads. A larger gang, in an important terminal, necessitates an excess amount of switching to clear tracks on which the men can work and spreads the work over such a large area that it slows up yard switching. Tracks taken out of service are usually restored to traffic each night. As it is usually the duty of the regular section gang to unload and distribute the material required by the floating gangs and also to pick up released material it is difficult for it to serve an oversized floating gang. In the case of ties, distribution can not be made far in advance of actual use; ordinarily it must be done the same day. Likewise the old ties must be picked up and loaded at the close of the days work in order to release the track worked over and obtain the use of others for the following day.

With a large unit terminal organization, power machinery of various kinds can be utilized to advantage. Power saws, air compressors, tie tampers, grinders, bolt tighteners, welding units, and tractors are indicative of the labor-saving machinery to be found in common use in terminal track work. The power drill is an especial aid in terminal work for with this tool from 80 to 125 bolt holes may easily be drilled in an eight-hour day. Few roads are at present using power bolt tighteners on frog and guard rail bolts, yet these bolts, as well as those at the heel of the switch, are difficult to keep tight under the strain of constant lead switching. A suitable machine for servicing these bolts would do much to prolong the life of switch material. Any large terminal could keep a machine of this kind busy continually.

While it is only in the comparatively recent past that the grinding of switch points and stock rails has been considered advisable, power grinders have already proved their worth in terminal work. By grinding off the overflow on stock rails and switch points the parts fit together much better, while many replacements of stock rails are avoided. One large terminal that has been doing grinding only for the past two years reports that not a single switch point has been climbed where grinding has been done in that time. Figures for this road show that the cost of this work is less than 80 cents per switch, including the grinding of both points and stock rails.

Most large terminals are provided with self-propelled power cranes, capable of handling one or more cars. Such cranes enable a foreman to unload his material directly from the car at the place where it is to be used. Old ties are piled in groups of 15 or 20 and loaded in gondola cars quickly. As the ties for the job are usually loaded in gondolas, the same cars, when unloaded, can be used for loading the old ties. One terminal roadmaster reports having loaded over one hundred cars of old ties last season by this method, at a cost of three-quarters of a cent per tie.



Large Terminals Present Many Problems to the Roadmaster

One or Two Floating Gangs

If only a single floating gang is available it is the opinion of the committee that it should do all classes of work, while if there are two gangs one can do the rail work and the other ballast and tie renewal. The local section gangs should do the lighter work of tie renewal, rail repair and other light maintenance where this is not sufficient to justify a floating gang.

Where the climate permits, a floating gang has a place in terminal maintenance the year round. During the summer, surfacing and tie renewals will occupy the greater part of its time, while in the winter, rail and switch work may be carried on. Year-round stabilization of the gang will attract the best class of labor and will result in both better and greater production per man.

Section gang laborers receive about the same rate of pay as the men in the floating gangs. Where there is a difference in the rate it is in favor of the section laborer.

A few roads feel that section gangs do better work than floating gangs and therefore prefer them. One engineer maintenance of way states that the foreman of the local gang knows better what maintenance is needed in his territory and that he takes pride in his section and will therefore strive for better work than a floating gang foreman might. It is the opinion of this committee that section gangs, as a rule, do better work but at a much higher cost and with a far greater tying up of terminal trackage than if the same work is done by a floating gang. The worst than can be said regarding the floating gang is that it substitutes quantity for quality to some extent. It can not be gainsaid that an efficient floating gang can work over more tracks in one season than a section gang that is confronted with innumerable tasks of every kind. The quality of the work done by a floating gang is a responsibility of the roadmaster and he may set the standard as high as he wishes. The com-

mittee feels that from the standpoints of economy and expediency the floating gang belongs to the present day terminal organization.

Programming the Work

The programming of terminal work is a highly controversial subject. Owing to the multiplicity of tasks that terminal section gangs are called upon to do, it is almost impossible to program the entire labor allotment. Short-notice jobs will occupy the time of six to eight men on gangs whose territory averages 50 miles of tracks and 300 switches. The work performed by any number of men in excess of these may be programmed successfully. Practically all roads program rail renewals as well as most ballasting and tie renewals in terminals.

The program is sometimes formulated verbally between the roadmaster and the foreman while in other instances a foreman submits a program to his roadmaster who revises it before permitting it to go into operation. Again the roadmaster, with the assistance of the division engineer, may prepare the entire program.

One road has developed the following program procedure: An annual budget is prepared, showing in detail the work to be done and the estimated expenditure for the year. This is gone over carefully by the engineer maintenance of way and the roadmaster. Rail relay and other important heavy work is scheduled to be done by months. Cross tie renewals are scheduled to be completed by the end of August and switch tie renewals by the end of October.

A budget is then prepared monthly and submitted to the management for approval. These budgets are so prepared that rail, cross tie and switch tie renewals, reballasting, etc., will be done in the period previously tentatively set up. This program is followed as closely as possible, subject of course, to orders for the deferring of work by the management and the addition of incidental jobs that develop from time to time. Nevertheless, the program is followed throughout the year as closely as possible. When the monthly budget is approved, the roadmaster is informed of the rail relay work to be done, the number of ties allotted for the month, etc. The roadmaster then sets the time for these relay jobs to be done by his extra gangs, allots the number of ties to each section, and otherwise programs his work.

As a rule, the work in terminals is programmed in a general way for the year, while the detailed program is prepared from month to month. The section gangs are able to follow these programs with reasonable closeness. Some gangs fall behind, due to unforseen circumstances, while gangs in other parts of the terminals will run ahead of schedule. The latter then assist the backward gangs to get abreast of their programs.

During Times of Heavy Business It Handicaps Trainmasters and Yardmasters to Give Up Important Tracks

One terminal roadmaster states that he is never able to complete his program on account of insufficient force. Here, in the opinion of the committee lies the crux of the whole matter. Most roadmasters receive monthly allotments of money or men without regard to the work planned for that particular month, even though the material for this work may already be on hand. This is particularly discouraging when the work in question is of a vital nature. Labor allotments ebb and flow with car loadings and net earnings. Much closer adherance to programmed work could be had if allotments of men and materials were more stable.

It is not customary for all terminal gangs to follow similar programs at the same time, except in a general way. Switching may be heavier in one part of the terminal in the spring of the year. Rail may be especially bad in another part of the yard, making it necessary to lay steel in one place while renewing ties elsewhere, for rail is sent where needed most and laid as received. With the exception of rail laying, terminal gangs can, for the most part, do the same class of work simultaneously.

To quote a terminal officer of a middle western road: "I believe that the programming of terminal section work is not only advisable but necessary. One can certainly accomplish more in a day if it is known in advance what is to be done." It puts foremen on their mettle to complete during a month the schedule that is set up for them by their roadmaster. On the other hand, if a foreman fails to measure up to his allotment a few times, without sufficient cause, there is a good reason to inquire into his capabilities as a foreman. Without the programming of terminal work during recent years it is doubtful if these properties could have been maintained to their present high standard.

Costs Being Reduced

Figures submitted to this committee by more than fifty representative roads in the United States and Canada indicate that the cost of maintenance in our larger terminals was 70 percent less in 1934 than in 1924. Various factors are responsible for this reduction, among which is the use of heavier track materials. A few roads report that they are using the same weights of materials as in 1929 but all agree that the weights of rails and fastenings have increased materially since 1924. It is highly improbable that we could have maintained our terminal trackage safely with the force employed in 1934, even taking into consideration the decrease in traffic, if we still had the lighter materials that were in service in terminal tracks in 1924.

Without exception, every road reporting states that its terminals are being maintained more cheaply than at any time in the past. Better rail, treated ties, improved joint fastenings, and large tie plates are in common use in every terminal. Spread track has been largely eliminated by the use of tie plates and treated ties.

The use of manganese frogs in crossings has greatly prolonged the life of such construction. Reinforced switch points, the widespread use of gage plates, heavy switch plates and rods, and the heavier sections of rail that are being laid today constitute overwhelming proof of the increased economy that resulted from heavier and improved track materials.

Most terminal tracks have a large amount of light rail. Most of this rail is laid in less important tracks,

where it is not subjected to a great deal of wear. Much of it is in poor condition because of many years of corrosion rather than wear. As more rail is laid in main lines, heavier second hand rail will be released for relaying yard tracks in terminals. Very little new rail is now laid in terminals for terminal requirements are usually met by using sawed rail released from main lines. Every section from 56 lb. to 141 lb. is to be found in terminal tracks today.

Standardization of track materials, especially rail, would simplify terminal track maintenance greatly, for today it is not uncommon to find 20 sections of rail in a single large terminal, with 10 to 12 different frog angles, 6 to 8 different kinds of joint bars for the same section of rail and every conceivable kind of tie plate and rail anchor. A stranger coming into a terminal is impressed invariably by the variety of designs. Not all tracks need be laid with 131 lb. rail, nor does the committee feel that 56 lb. rail is desirable. Some standardization is possible, indeed necessary, particularly in terminals where the odds and ends of experimental designs naturally gravitates. To say that all track materials should be rigidly standardized would be to retard invention and future improvement. However, some means must be found to eliminate the present tremendous waste through minor variations of no essential value. When this occurs the terminal roadmaster and foreman will be in a much better position to hold down their stocks of material and raise the general standard of their track maintenance.

To some extent, heavier cars and locomotives, as well as faster switching, have offset the increased weight of materials in terminal tracks. Car capacities have increased from 42.7 tons in 1923 to 47.5 tons in 1933, approximately 10 percent. Switching is 20 percent faster than in 1924. Yet derailments on terminal tracks have never been less than today.

Since 1924, the best figures available indicate that there has been a 75 percent decrease in derailment costs, resulting from improved track conditions in terminals. Indeed, one of the largest terminals in Chicago reports that the number of derailments due to track conditions was reduced from 122 in 1925 to 22 in 1934, or 82 percent, while damage to cars, measured in dollars, was reduced by 92 percent. Derailments in recent years have, for the most part, been on those tracks where lighter rail is still in use. Switching leads of special importance should be laid with 100 lb. rail as a minimum. Industry track turnouts should be restricted to a maximum curvature of 16 deg. and all curves in terminals held well within the maximum of engine safety.

Maintenance of Way and Structures Selected Accounts

	1923	1932
Roadway maintenance, yard	$ 9,151,882	$3,075,644
Ties, yard	14,044,390	5,967,127
Rails, yard	2,892,013	1,602,330
Other track material, yard	8,120,597	3,128,270
Ballast, yard	494,666	125,925
Track laying and surfacing, yard	24,436,284	9,048,930
Crossing and signs, yard	1,522,333	592,265

Treated crossing planks are economical in locations where mechanical wear is not heavy, although most highway crossings in metropolitan areas are subjected to such heavy wear that no real economy results from the use of treated material. The use of asphalt preparations and the wider use of pre-cast slab and steel crossings minimize the work of section men in crossing maintenance.

The cost of present day terminal maintenance has been reduced not only by the use of heavier fastenings and rail, but also by the improvement in terminal organizations, by lower costs of material, greater efficiency of labor, the adoption of labor-saving machinery, an advanced educational program, and a decrease in traffic. Nor should it be overlooked that improved rolling stock has taken some of the strain off switching leads and terminal tracks. All of these are important factors in the final result.

Much has been said of late regarding deferred maintenance, with the implication that the railroads are greatly undermanned and underequipped, pending the day of better business. It is true that rail and tie renewals have not been as heavy as they were in the halycon days of 1928 and 1929, although the latter is a natural result, in part, of the increased installation of treated ties in the years immediately prior to 1929. Material has been used with greater care and labor employed with greater discrimination. It is doubtful if the railways will ever again employ as many men per mile of maintained track as in the past. The lesson of the depression years has been learned for with lessened revenues, economy has become a necessity. Track materials are being applied more judiciously and under better supervision and after application, are being continued in track longer by reason of better maintenance.

In conclusion, the committee believes that there are fewer derailments in terminals today than at any other time in railroad history, switching is faster than ever before, and new trains are being operated on greatly accelerated schedules on many roads. American railway terminal tracks have never been maintained more safely or economically than today.

A. H. Peterson (chairman) roadmaster, C. M. St. P. & P., Chicago; F. H. Masters, assistant chief engineer, E. J. & E., Joliet, Ill.; J. P. Corcoran, supervisor, Alton, Bloomington, Ill.; L. M. Denny, supervisor, C. C. C. & St. L., Indianapolis, Ind.; R. H. Carter, acting division engineer, I. C., Chicago; R. Hurlburt, roadmaster, C. B. & Q., Dakota City, Neb.; W. Francis, roadmaster, St. L. S. W., Waco, Tex.; J. A. Roland, roadmaster (retired) C. & N. W., Missouri Valley, Ia.; H. M. Smith, roadmaster, N. & W., Eckman, W. Va.; C. T. Mulcahy, roadmaster, S. P., Nieland, Calif.; W. C. Peters, yard foreman, A. T. & S. F., Wichita, Kans.; J. F. Talbot, supervisor, B. & M., Boston, Mass.; P. F. Muller, roadmaster, C. & W. I., Chicago; and J. C. Runyon, supervisor, C. & Q., Covington, Ky.

Discussion

A large portion of the discussion that followed the presentation of this report dealt with the statement in the report that "all members of the committee are in agreement that we had too many foremen in the past and that the present system is more satisfactory." L. M. Denny (C.C.C. & St. L.) took issue with this statement, saying that during the years 1927-29, when traffic in terminals was exceedingly heavy and dense, it was not possible to obtain the release of sufficient trackage to permit the use of large gangs. W. H. Sparks (C. & O.) felt that this statement constituted a reflection on the maintenance of way department, and that it should be emphasized that whatever reduction has been made in the number of foremen necessary at terminals has been due to better materials, to the use of mechanical equipment and to progress made in the education of track foremen. J. B. Kelly (Soo Line) stated that generally speaking, the demands on the roadmaster's time are so heavy that he does not have time to give the necessary supervision to large terminal gangs. However, if this objection was not present or could be removed, he favored the larger gangs.

In support of the statement in the report Mr. Peterson cited the experi-

ence of his road with larger gangs in its Chicago terminals. These terminals, involving approximately 360 miles of tracks, are now maintained by 6 gangs of 10 to 20 men, as compared with 24 gangs formerly. He contended that maintenance conditions in these terminals are superior to what they were before the new organization was placed in effect, and pointed out that the derailment figures given in the report are for these terminals. With the reduction in the number of foremen, he said, there has also been a saving in the time consumed in making out time sheets and other reports that track foremen are required to make. Furthermore, he said, the larger gangs have sufficient men to do all types of heavy work and for this reason, no "doubling up" is required.

Mr. Peterson was supported in his stand by William Shea (C.M. St. P. & P.) who pointed out that it is possible to supervise six foremen much more closely than 24. He stated also that it was not uncommon for his road to obtain the release of tracks in busy terminals in former years for the purpose of doing maintenance work with large gangs. In this connection, Mr. Peterson said that while the operating department is still opposed to releasing yard tracks to maintenance gangs, there seems to be a tendency to extend a greater degree of co-operation along this line than was formerly the case. With gangs of 50 to 75 men, he pointed out that it is not necessary to take more than one or two tracks out of service at a time.

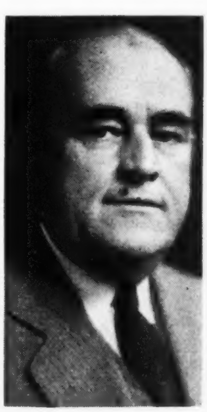
R. M. Blaydes (K.C.S.) asked if it were customary to program work in yards having from 25 to 30 miles of tracks and about 100 switches. Mr. Peterson replied that it was his impression that programming was not only customary but desirable in such yards. J. J. Clutz (Penna.) inquired if the committee thought it possible to provide the yardmaster with a program so that he would know in advance what tracks the maintenance department would want released. Mr. Peterson replied in the affirmative and added that on his road it is customary to plan out-of-face work, such as heavy tie renewal and rail relaying work, with the co-operation of the operating department so as to minimize the difficulty of getting the tracks released when they are wanted.

E. E. R. Tratman (consulting engineer) asked if snow melters are being used in freight terminals to the same extent as in passenger terminals and pointed out that, if this is so, it is necessary to provide for thorough drainage. Mr. Peterson replied that snow melters are used extensively at interlocking plants and described a snow melter that he said was being used by at least two roads on freight switching leads. G. E. Boyd (*Railway Engineering and Maintenance*) cited the case of one railroad that uses weed burners to melt snow around switches and car retarders.

T. Thompson (A.T. & S.F.) asked for additional information concerning the duties of the track inspectors mentioned in the report. Mr. Peterson replied that the inspector goes over a different track in the terminal each day and inspects closely all interlocking plants, crossings, frogs and switches. Any defects discovered are corrected by the inspector or, if this is not possible, he gets in touch with the roadmaster or the foreman, in the meantime taking the necessary precautions to protect traffic.

The Track Supply Exhibit

THE exhibit of track materials and supplies of the Track Supply Association has become a well-nigh indispensable feature of the annual convention of the Roadmasters Association. Last year, in spite of serious obstacles imposed by conditions rising out of three years of inactivity, the Track Supply Association put on an exhibit that, in both number and quality of exhibits presented, was a credit to the organization. The success of that exhibit gave additional momentum during the intervening period, with the result that 40 companies exhibited their products this year.



Geo. T. Willard
President

The officers of the Track Supply Association who were responsible for the preparation and conduct of this year's exhibit were: President, Geo. T. Willard, P. & M. Co., Chicago; vice-president, Frank J. Reagan, American Fork & Hoe Co., Chicago; secretary-treasurer, Dan J. Higgins, Gardner-Denver Co., Chicago; directors, Jess Mossgrove, Austin-Western Road Machinery Co., Aurora, Ill.; Lewis Thomas Q. & C. Company, Chicago; Lem Adams, Oxweld Railroad Service Company, Chicago; and H. H. Talboys, Nordberg Manufacturing Co., Milwaukee, Wis.

This year the association decided to increase the number of officers and directors, and in the election Mr. Reagan was advanced to president; Mr. Talboys to first vice-president, and Mr. Mossgrove to second vice-president; Mr. Higgins was re-elected secretary-treasurer; and the following were elected to the board of directors: For two-year terms, Messrs. Adams, Thomas and R. J. Platt, Sellers Manufacturing Company, Chicago. For one year, Earl E. Thulin, Duff-Norton Manufacturing Company, Chicago; R. J. McComb, Woodings-Verona Tool Works, Verona, Pa.; and K. K. Cavins, Fairmont Railway Motors, Inc., Chicago.

List of Exhibitors

Air Reduction Sales Company, New York; welding and cutting equipment; oxygen and acetylene regulators; carbide lights, lamps and lanterns, welding rods,

Dan J. Higgins
Secretary-Treasurer

goggles, built-up and heat-treated rail joints; C. A. Daley, E. M. Sexton, B. N. Law, R. T. Peabody, J. F. Callahan, W. A. Andrews, Jr., W. H. Handrock, J. W. Kenefic, L. C. McDowell and M. M. Weist.

American Fork & Hoe Company, Cleveland, Ohio; rail anchors, tapered rail-joint shims, shovels, weed cutters, forks, rakes, scuffle hoes and broom rakes; Frank J. Reagan, G. L. Dunn, S. L. Henderson, C. E. Irwin, J. J. Nolan, F. C. Stowell, H. C. Branahl and T. A. Lawson.

Austin-Western Road Machinery Company, Aurora, Ill.; models and moving pictures, and literature on air dump cars; Jess Mossgrove, H. B. Bushnell, Bruce Smith and J. D. Benbow.

Barco Manufacturing Company, Chicago; gasoline tie tampers, stoves, sand dryers, and flexible ball joints; C. L. Mellor, C. O. Jenista and N. B. Robbins.

Buda Company, Harvey, Ill.; light section motor car, inspection motor car, mechanical tamper, switch stand, bonding drill, track liners, rail bender, track jacks; R. M. Blackburn, H. S. Brown, R. B. Fisher, G. A. Secor and H. C. Beebe.

Creepcheck Company, Inc., Chicago; rail anchors; T. D. Croweley and N. A. Howell.

Duff-Norton Manufacturing Company, Pittsburgh, Pa.; track jacks, power jacks, journal jacks, automatic lowering jacks and tie spacers; C. N. Thulin, E. E. Thulin, A. Roberts, G. C. Hutchinson, Jr., Dave Evans, J. J. Gilchrist and Thomas Baum.

Electric Tamper & Equipment Company, Ludington, Mich.; Universal tamper, ballasting and tamping blades and tips, and concrete vibrator; C. Jackson, H. W. Cutshall, V. G. Cartier and G. W. Walters.

Fairbanks, Morse & Co., Chicago; light section car, inspector's car, panel display of magneto, cam ground piston with interior cooling ribs, connecting rod, air-cooled spark plug, one-piece crankshaft and Timken bearings, Timken axle box roller bearing, steady bearing with ball joint in live rubber, and dual control carburetor; C. H. Wilson, E. C. Golladay, W. L. Nies, E. P. Chase, B. S. Spaulding and C. B. O'Neill.

Fairmont Railway Motors, Inc., Fairmont, Minn.; inspection car, section car and heavy-duty motor car; W. F. Kasper, W. D. Brooks, Kenneth K. Cavins, Arthur R. Fletcher, H. A. Sly, C. P. Benning, C. J. Dammann, J. E. Simkins, V. Pagett and C. H. Johnson.

Illinois Malleable Iron Company, Chicago; rail anchors, H. A. Morean, Chas. G. Eriscon and W. T. Kelly.

Ingersoll-Rand Company, New York; pneumatic tie tamper, track wrench, rail drill, spike driver, rivet buster, riveting hammer, chipping hammer, holder on, air-line lubricator, safety saw, sump pump, wood borer, screw-spike wrench, clamp bolt wrench, impact wrench, grinders and scaling tool; Wm. H. Armstrong and G. W. Morrow.

O. F. Jordan Company, East Chicago, Ind.; model of spreader ditcher; H. M. McFarlane, J. C. Forbes and A. W. Banton.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.; one-man inspection car, motor-car engine, motor-car wheels, track gage and level; Frank E. McAllister, Ralph E. Keller, L. W. Bates and P. J. Robischung.

Lundie Engineering Corporation, New York; tie plates and rail lubricator; L. B. Armstrong and O. W. Youngquist.

Maintenance Equipment Company, Chicago; switch point protector, rail and flange lubricator, model of friction car stop and literature on rail layer and switch point protector; T. E. Rodman, D. M. Clarke and E. Overmier.

Mall Tool Co., Chicago; portable rail grinders and flexible-shaft cross-grinding and nut-setting equipment; A. W. Mall, F. A. McGonigle, M. Elrick and R. A. Gramer.

Morden Frog & Crossing Works, Chicago; heat-treated forged compromise joints, adjustable rail braces and miscellaneous forged fittings for switches; W. Homer Hartz, E. C. Argust, G. F. Killmer, Sam Withrow and L. I. Martin.

Nordberg Manufacturing Company, Milwaukee, Wis.; rail grinders, power jack, utility grinders and accessories; H. H. Talboys, W. W. Fitzpatrick and C. P. Clemmens.

Northwestern Motor Company, Eau Claire, Wis.; hump and extra gang car, section car and inspection motor car; motor car wheels, rail joint slotter, rail and frog surface grinder; F. W. Anderson, A. H. Nelson, Otis B. Duncan and W. J. Roehl.

Norton Company, Worcester, Mass.; grinding wheels, pictures of grinding machines in operation; W. E. Shumway, R. E. Taylor, W. N. Jove, I. W. Stanton and H. E. Walston.

Oxweld Railroad Service Company, Chicago; oxy-acetylene welding and cutting apparatus; L. C. Ryan, Lem Adams, W. H. Kofmehl, D. H. Pittman, J. R. Garrett, S. P. Donegan, F. J. Duffy, J. C. Stephenson and W. E. Donalds.

P & M Company, Chicago; rail anti-creepers and bond-wire protectors; D. T. Hallberg, G. T. Willard, W. A. Maxwell, J. E. Mahoney, G. E. Johnson, G. E. Webster, J. J. Gallagher and P. H. Hamilton.

Pettibone Mulliken Company, Chicago; switch stands, switch point lock and mechanical switchman; G. J. Slibeck, J. B. Campbell, G. R. Lyman, C. Johnson and C. F. Landberg.

Pocket List of Railroad Officials, New York; copies of Pocket List of Railroad Officials; H. A. Brown and B. J. Wilson.

Positive Rail Anchor Company, Chicago; rail anchors and guard-rail plates and braces, adjustable rail braces; A. H. Told and L. C. Ferguson.

Power Ballaster Co., Chicago; moving pictures of track skeletonizer; F. H. Philbrick, Hobart Newman and H. Christy.

Q & C Company, New York; Guard rail clamp, switch point guard, tie plate and rail fastening, electric snow melter, compromise joint, derail, gaging tools, anti-slip rail tongs and gage rods; J. L. Ferry, L. E. Hassman and Lewis Thomas.

Rail Joint Company, New York; insulated and standard rail joints; E. A. Condit, Alex Chapman, C. B. Griffin, Harry C. Hickey, G. H. Larson, Thomas Ryan and R. W. Payne.

Railway Engineering and Maintenance, Chicago; copies of *Railway Engineering and Maintenance* and Railway Age; Elmer T. Howson, F. C. Koch, W. S. Lacher, H. A. Morrison, J. G. Little, G. E. Boyd, H. E. McCandless, M. H. Dick and S. W. Hickey.

Railway Purchases & Stores, Chicago; copies of Railway Purchases and Stores; K. F. Sheeran and J. P. Murphy.

Railway Track-Work Company, Philadelphia, Pa.; portable electric track grinder, portable stock-rail grinder, rail-joint cross grinder, portable reciprocating grinder, portable flexible shaft grinder and grinding wheels; A. M. Nardini and Henry Perazzoli.

Ramapo Ajax Corporation, New York; full-size model highway crossing, switch points, switch stands, guard rail clamp, adjustable rail brace, limit gage, clips, sanitary water carrier, reversible manganese steel crossing and gage rods; J. B. Strong, T. E. Akers, J. E. Davidson, G. M. Cooper, G. A. Carlson, R. E. Einstein, D. Fairback, D. F. Hilton, P. Hoffman, J. S. Hutchins, A. F. Huber, W. Perdue and W. Bender.

S. E. Rawls Company, Streator, Ill.; railway track and right-of-way mowing equipment; S. E. Rawls, C. F. Butts and M. E. Rawls.

Republic Steel Corporation, Massillon, Ohio; curve guard rail, tie plates, lockers, filing cabinets, steel fence posts, wire, nails, staples, track spikes, track bolts and nuts, steel tubing, electric conduit; W. T. O'Neill, E. K. Conneely, C. F. Newpher, A. D. McAdam, R. C. Klemm, C. H. Aiken, H. C. Ellison, C. H. Ellison, N. A. Boerger, Kenneth Murray, C. J. Erdman, C. W. Ruth and W. B. Long.

Sellers Manufacturing Company, Chicago; wrought iron tie plates and angle bars; G. M. Hogan, R. J. Platt, R. A. Van Houten and J. T. Flynn.

Teleweld, Inc., Chicago; rail joint shims, samples of welded rails showing effects of pre-heating, samples of heat-treated rail and field hardness testing kit; A. M. Wood, C. R. Fohs and G. A. Green.

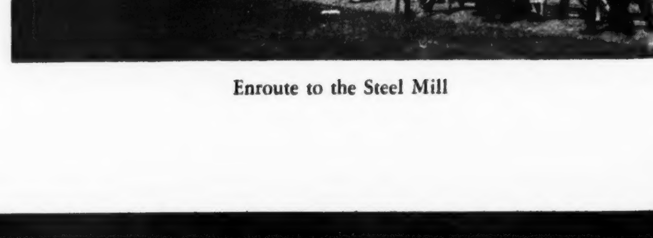
Templeton, Kenly & Co., Chicago; track and bridge jacks, G-Y tie spacer and rail puller expander; George L. Mayer, Chas. Neher, W. B. Templeton and R. B. Hill.

Toncan Culvert Manufacturers' Association, Youngstown, Ohio; corrugated culvert pipe; F. A. Kelly and R. W. Roof.

Woodings-Verona Tool Works, and Woodings Forge & Tool Company, Verona, Pa.; rail anchors, gaging tool, track levels and gages, spring-clip and bent-shoulder tie plates; R. J. McComb, W. H. Woodings and A. C. Laessig.

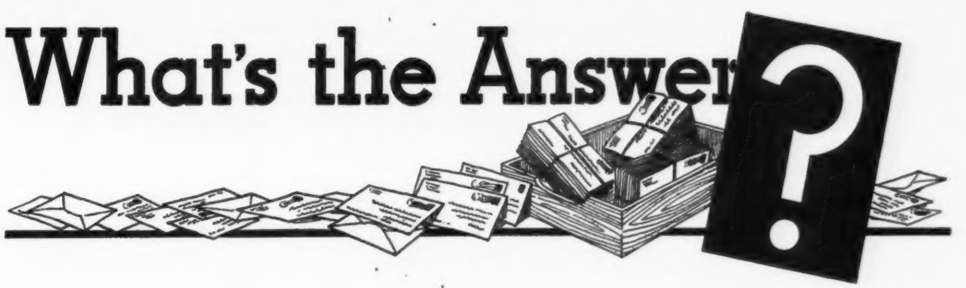
Non-Exhibiting Members

American Steel & Wire Company, Chicago
Blatchford Corporation, Chicago
Chicago Pneumatic Tool Company, New York
Cleveland Tractor Company, Cleveland, Ohio
Cullen-Friestedt Company, Chicago
A. P. deSanno & Son, Inc., Chicago
Eaton Manufacturing Company, Reliance Spring Washer Division, Massillon, Ohio
Hubbard & Company, Chicago
Inland Steel Company, Chicago
National Lock Washer Co., Newark, N. J.
Warren Tool Corporation, Warren, Ohio



Enroute to the Steel Mill

What's the Answer?



Inspecting for Bolt-Hole Breaks

Should rails be inspected for incipient breaks through the bolt holes before they are built up by welding? Why? If so, how should the examination be made?

Visual Examination Sure

By C. B. Bronson
Inspecting Engineer, New York Central, New York

To a large degree this question ties in with that of applying new bars to the rail when building up the ends by welding, which was discussed on page 522 of the September issue. Owing to the restricted rail purchases of the last few years it has been necessary to concentrate more and more on the problem of what to do with our joints and rail ends. While this is by no means a new problem it has become of more importance as we have faced the necessity for extending the life of the rail. I have had considerable to do with our rail-welding policy and practice, for which reason I have made many field observations to determine the condition of the joints and rail ends, during the last five years. It seems desirable, therefore, first to mention our own experience.

On practically all of the mileage of our principal lines we are using joint bars either 36 or 38 in. long, supported on three ties, and in these joints the occurence of a bolt-hole break is rare.

In fact, removals because of breaks through bolt holes represent considerably less than five per cent of our total removals of broken and otherwise defective rails, while on many stretches of track, even under the heaviest traffic conditions, this type of failure occurs so infrequently as to be negligible.

Almost invariably, however, we remove all of the joint bars just prior to building up the rail ends by welding, because we make it a practice to replace them with either new or reformed bars, or we reverse the old bars and apply head shims. The purpose of this is to compensate for the wear that has taken place on the fishing surfaces and to insure that the rail ends and joint bars are again established on a basis which will permit them to work in unison, instead of hinging. As the bars are removed the surfaces behind the joint are cleaned thoroughly and inspected for any possible cracks in the holes, and a liberal application of oil is made to both the rail and the bars, particularly on the fishing area.

We seldom need to build up fairly new rail, and when it occasionally becomes necessary to do so, the joint bars are not disturbed. We consider that the probability of a bolt-hole failure, or even incipient cracks, is so remote that the added expense of making the examination would not be justified.

So far as other roads are concerned, I believe that they should do as we are doing. That is, when they intend to build up the ends of the older rail by welding they should change or remove the bars, not only to examine the bolt holes for breaks, but to correct the looseness in the joint in one of the ways already mentioned. This is a matter of field study to determine how the joint bars are acting under load and of measurements by feelers or other means to find how much play exists.

If a particular road is troubled with bolt-hole breaks, it would be advisable to remove the joint bars anyway, regardless of whether they are to be replaced, repaired or shimmed in advance of the welding. Obviously, building up the rail ends reduces the amount of pounding at the joint and thereby relieves the strain on the whole joint assembly, so that bolt-hole breaks are, or should be, less likely to occur than on badly battered and dipped rail ends.

Where a road contemplates building up the ends of newer rail, in general, it does not seem that it should be necessary to remove the joint bars to inspect the rail ends for incipient cracks or bolt-hole breaks, unless individual experience has demonstrated that early bolt-hole breaks have developed.

Where the joint bars are in good shape, the whole matter boils down to individual judgment and experience as to the desirability of removing the

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered In December

1. *Should a highway crossing surface be higher or lower than the top of rail? Why? If so, how much?*
2. *What are the advantages and disadvantages of supporting the rail directly on the floors of concrete bridges or on concrete decks of steel bridges, as compared with ties and ballast?*
3. *On single track, should the ties be lined with the outer or inner rail on curves? Why?*
4. *When a concrete station platform settles unevenly, must the uneven portion be replaced or can it be resurfaced? If the latter, how?*
5. *Should a portable snow fence be vertical or inclined? Why? If the latter, should the inclination be toward or away from the direction of the prevailing wind? Why?*
6. *What is the difference between a single-stage and a multi-stage pump? Under what conditions should each be used?*
7. *What are the advantages of snow-melting pits in yards and terminals? Where should they be placed and how constructed? How heated?*
8. *How does one determine whether a pile is being overdriven?*

bars ahead of the rail-end welding.

Without doubt, the surest method of detecting cracks is by visual examination, which necessitates the removal of the bars. It has been said that by tapping the sides or top of the rail head, cracks that have developed to any considerable magnitude can be detected by the hollow sound of the blow, but I do not place much reliance in this superficial method.

Should Be Examined

By J. G. Hartley
Assistant Engineer, Pennsylvania, Philadelphia, Pa.

Since under wheel loads there is always a certain amount of movement of the rail ends in the splice bars, there is always a possibility that inherent rail metal defects will develop or service failures occur, this possibility varying with the age of the rail, the speed of trains and the annual gross ton miles carried by the rail. The building up of battered rail ends by welding requires the application to the surface of the rail of heat, which penetrates to the web, the depth depending on the type of equipment used. Cooling will increase any incipient cracks which may be present and may, finally, result in breakage of the rail. For these reasons, all rail ends which are to be built up by welding should be examined for defects.

If properly performed, the building up of the ends by welding will lengthen the life of the rail from three to eight years, depending on train speeds and the annual gross tonnage. It is essential, therefore, that the condition of the rail and the rail ends be as good as possible before the welding is done. All splice bars which do not have sufficient drawing space between the bar and the rail fishing to insure a proper fit of the bar to the rail should be replaced with oversized reformed bars. It is my conviction that all rail ends to be built up should have the old bars replaced with oversized reformed bars, that the bolts should be tightened in the same way as when laying new rail and that, when necessary, the joint ties should be renewed, in order that joint drainage be insured and the track brought to a good surface, before any welding is done. When the splices are renewed, the rail ends can be examined for incipient or well developed cracks, after the surfaces have been brushed with a steel-wire brush.

Gage at Railway Crossings

What practical methods can be employed to maintain correct gage at railway crossings?

Several Methods Possible

By George J. Slibeck
Sales Engineer, Pettibone Mulliken Company, Chicago

Several methods are available, but the one to be used in a given case will depend on the kind of crossing, the equipment on hand and the co-operation of the management. First, however, it will be necessary to analyze the reasons why crossings get out of gage. The principal reasons, which is beyond control of the roadmaster, is that many freight car wheels are out of gage or do not line parallel with the axis of the car. To correct this it is obviously necessary to enlist the co-operation of the mechanical department.

When the gage of the wheels is narrow, the flanges strike the guard and tend to pull the crossing together. If the wheels are slued slightly, the same thing occurs. In both cases, the crossing will be pulled out of line, while there will be other serious results. If the crossing is of bolted construction, the rails will creep, also throwing the crossing out of line and consequently further out of gage. The sharper the angle of intersection, the greater is the probability of creepage in the rails.

On a manganese crossing this condition of the wheels tends to form a lip on the running rail, which succeeding wheels may break off, leaving a spalled place. This spalling occurs more particularly at the intersecting corners. The only recourse to holding gage on a bolted crossing against the action of bad wheels is to register a complaint to the mechanical department, line and regage the crossing and apply enough anti-creepers to hold the rails on all four sides against movement.

On a manganese railway crossing, the lip should be kept ground off as it forms; otherwise welding will be necessary much sooner than it should. The A.R.E.A. has attempted to minimize this damage by recommending $1\frac{7}{8}$-in. flangeways, which give the wheels more room to wobble.

Crossings also get out of gage by reason of their design. A bolted crossing is an assembly of members bolted together. But no bolt ever made will stay tight on a bolted rail crossing. Formerly, bolts got loose not so much from stretching as from distortion of the threads. This has been overcome largely by the use of heat-treated bolts and nuts, but other conditions have their influence. Every rain, particularly in the summer when followed by a hot day, causes oxidation on the contacting surfaces of a bolted crossing, thus causing loss of metal, and in the course of time, the need for retightening the bolts. I have seen many crossings that were out of gage permanently from this cause. I have also seen nests of crossings that had to be replaced long before their natural life cycle was completed because the gage could not be maintained in the face of this weather and rust condition. The only recourse in this case is to get away from bolted rail crossings.

Gage troubles are about the same in solid manganese, manganese inserted and articulated manganese crossings, generally by reason of the mashing or lipping of the manganese steel, which is a natural characteristic that can be remedied readily.

When manganese steel is first installed in the track, it has a Brinnel hardness ranging from 180 to 200. Cold rolling by passing wheels eventually brings this to 450. The cold-rolling action compacts the metal, but in the process, which usually requires from three to four months, leaves a lip projecting into the flangeway, thus tightening the gage. This lip does not slough off, as it would on open-hearth steel, but when it becomes too prominent some wheel will break it off, at the same time tearing some of the base metal away with it. Trackmen formerly paid no attention to this damage but when it had progressed to the point of approaching failure, they ordered a new crossing. Today they have a better understanding of the situation and grind the lip off as it forms.

Solid manganese crossings are subject to fewer gage troubles than any other design, but have other less desirable features than either the manganese insert or articulated types. The insert type probably gets out of gage more particularly because it is of bolted construction than for any other reason. The remedy is to keep the bolts tight and apply plenty of anti-creepers, especially if it is a "long-angle" crossing.

There was, and still is, more or less trouble with respect to gage on some of the older types of articulated crossings, because the corner pieces which fit into the side arms become worn and pounded when the fit is made, and this tends to close the flangeways.

This trouble has now been eliminated by making a machine fit for these pieces. When it occurs in the older crossing, it can be corrected by inserting shims to bring the flangeways back to gage.

In concluding, I want to call attention to the method employed by the Chicago, Milwaukee, St. Paul & Pacific for holding gage and line. This is done by welding a piece to the base plate to act as a stop against the turnout or crossing frog. Since all frogs consist of opposing angles, in this way one or the other of the stops resists movement when a train passes over the crossing. This scheme has been very successful. Another type of crossing that is just now coming into use, which may eliminate some of the troubles that have been mentioned, has a base of manganese alloy steel cast in one piece. The design is simple and economical. When a rail wears and is ready for removal, it can readily be taken out and replaced, leaving the base in the track. Either heat-treated or ordinary rails can be used. The one-piece base preserves the gage and line throughout its life. Some of these crossings are now in service on the Chicago, Burlington & Quincy.

Hold in Position

By C. H. Vogt
Track Supervisor, Central of New Jersey, Jersey City, N. J.

A new railway crossing is to correct gage and if no external forces act on it, all of its parts will remain in their respective positions. Rails creep, one sometimes more than another and one track will also creep more than another. If the crossing is square, this creeping will rotate it or push it out of line but will have little effect on the gage. If the angle is acute, creeping will tend to alter the gage, generally drawing it in. Such a crossing is diamond shaped, and it requires less force to distort a diamond than a square.

Obviously, the most important thing to do is to hold the crossing in its original position, and this can best be accomplished by applying anti-creepers on all approach tracks. Since creeping is never prevented absolutely, the crossings must be reset from time to time, the interval depending on the amount of traffic. Bumping the rails back is only a temporary solution of the problem.

They should be cut to the proper length to restore the original symmetry of the crossing and all anti-creepers should be reset. With the same degree of anchoring, the least trouble will be experienced with the solid manganese type and the most difficulty with the two and three-rail bolted types. This is not so apparent when the crossings are new, but as they wear the former remains as a unit, while the latter types develop numerous "hinges" and are more readily forced out of symmetry. Gage plates are sometimes used with the acute-angled type, and are particularly useful where creeping is excessive, because as the parts of the crossing wear the frogs become somewhat articulated.

Another type of gage tightening occurs in all bolted frogs, as a result of the wear that occurs on all contact surfaces, which permits the gradual closing in of the several parts as the bolts are tightened. Passing wheels keep the guard rails the proper distance apart, so that the closing-in movement occurs on the running rail, thus reducing the gage, sometimes as much as 1 in. in old crossings. Such a crossing should be replaced, although temporary relief may be secured by shimming behind the fillers to restore the normal flangeway, until replacement becomes necessary.

How Long Should a Pile Be?

How does one determine the proper length of piles for a pile trestle? For foundations?

Previous Records Best

By L. G. Byrd
Supervisor Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Many factors enter into consideration when determining the length of piles to be used in trestles or foundations, but where available, records of previous driving and later performance of the piles provide the most dependable information. In former years, most roads have neglected to keep pile-driving records, this work generally being left to the local foreman who was usually thoroughly familiar with the conditions surrounding the structures in his territory. He may have kept his own records, as many foremen still do, but they never got into the division or general bridge records, so that they are not now available. If the foreman was transferred or left the service, the record was lost and it was necessary to start at the beginning. The result has been that in too many instances bents are washed out, bridges get out of line for no apparent reason or give trouble from settlement.

It is our experience that when redriving trestles and records of previous drivings are not available, it is best to drive test piles at intervals of 250 to 300 ft. to determine the driving conditions and the load-carrying capacity for different penetrations to insure the minimum waste from cut-offs. In some cases borings will be justified, particularly for substructure foundations. Borings will usually give dependable information in sand and clay subsoils, but are generally useless where boulders are encountered. In driving test piles it is important to keep an accurate record of the number of blows, or strokes, of the hammer required for each inch of penetration below, say, 10 ft., and to file the record where it will be available for future information.

Should Penetrate 20 Ft.

By S. F. Grear
Assistant Engineer of Bridges, Illinois Central, Chicago

In the first place, trestle piles should have a penetration of at least 20 ft., unless they reach the point of refusal before arriving at this depth, and in general, this will be about the proper penetration. On our road, piles are bought and stocked in lengths which are multiples of 5 ft., so that for use the length must be determined to the nearest 5-ft. increment. In making this selection, however, the only proper method, in my opinion, is to drive test piles.

Piles selected for making the test should be of a size representing the average of those to be used in the structure and must be capable of withstanding the effects of hand driving. They must be driven either to refusal or well below the point where the desired bearing power is indicated. After the test pile has reached a penetration of about 10 ft., the number of hammer blows required for each additional foot of penetration should be counted, to afford data upon which to estimate the bearing power at any given depth. This record should also include the fall of gravity hammers or the speed of double-acting steam hammers.

Similar methods should be used to determine the length of foundation piles. Where the plan depth is only a few feet below the natural surface,

the test driving can be completed before any other work is started. In many cases, however, it is necessary to excavate a hole to the depth of the bottom of the footing to insure a proper test. If a supply of foundation piles of various lengths is readily available the test piles should not be driven until the foundation excavation has been completed.

Test Tiles Preferred

By W. J. Howse
Bridge and Building Foreman, New Orleans & North Eastern, Poplarville, Miss.

The plan of driving test piles appeals to me as the best and most dependable method of determining the proper length of piles for trestles and foundations. In many instances penetrations of from 18 to 20 ft. are difficult to obtain, for which reason it is generally safe to use test piles of sufficient length to give from 25 to 30 ft. of penetration, as there are few places where the latter will not be ample to meet all requirements. When driving test piles for trestles, it is advisable to make two or more tests, depending, of course, on the length of the structure and the character of the soil.

There are other methods of making tests of the soil conditions, such as boring or drilling, but they are frequently unsatisfactory and may be disappointing when the actual work of driving the piles gets under way. I have driven piles, the lengths of which have been based on such tests and have been forced to stop 75 per cent of them short of the expected penetration. Boring tests do provide some information with respect to the subsurface strata, but it is impracticable to estimate the resistance in the earth without actually driving test piles. For this reason, I would not recommend an outlay for piling solely on a test of this kind. My experience leads me to believe that the safest and least expensive course to follow in this respect is the practical, rather than the theoretical procedure.

Test Piles Are Best

By L. W. Skov
Office Engineer, Chicago, Burlington & Quincy, Chicago

Probably the best way to determine the length of piles for either pile trestles or foundations is to drive test piles. In many cases, however, this procedure cannot be followed. If it cannot and the project involves the renewal of an existing pile trestle, the length of the new piles can be determined from previous experience with the piles in the old structure. For new structures, test borings will provide the next best source of information, with the driving of metal bars rating third.

It is necessary frequently to determine pile lengths for structures in new locations without the benefit of any kind of tests. In such cases, previous experience with piles driven under conditions as nearly similar as possible as those at the new site is about the only guide available for making this determination.

Ventilating Pumping Stations

Is it essential to provide for ventilation at pumping plants where gasoline or oil engines are in service? If so, how should it be done?

Yes, As a Matter of Safety

By E. M. Grime
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

Usually, no special provisions are made for ventilation in the ordinary small station where a fuel-oil or gasoline engine is used. There have been sufficient fatalities from carbon monoxide poisoning, however, to make it desirable to provide some simple means for ventilation, even though it be nothing more than a small opening underneath the door, through which the poisonous gases, which are heavier than air, can escape at the floor level.

It is probable that one reason why this matter has not been given more attention is that in mild weather the door of the pump house is invariably open, while during cold weather a fire is maintained in the stove, thus creating sufficient draft to draw the impure air out through the chimney. The moving parts of the machinery also set up air currents which aid ventilation.

In a pumping plant of this type, the engine should never be placed in a deep pit or so located that the poisonous gases will readily flow into an adjacent pit where men may be required to work. The best practice is to design the pump house so that the floor will be slightly above the ground line. The design should also provide for an exhaust pipe of such size that it will freely carry away the gases of combustion. If heat, other than ordinary stove heat, is provided, special measures should be taken to ventilate the room by placing an opening to the outside, at the bottom of the door or elsewhere near the floor level. In some large pumping plants, it has been found desirable to provide a ventilating shaft and install an electric fan to improve ventilation.

Proper ventilation of any room in which a gasoline or fuel-oil engine is operated is important as a matter of safety, and one of the essential details is to maintain the engine in first-class operating condition, with no oil leaks at the carburetor or elsewhere. The gasoline or oil supply should be kept in a tank which is buried in the ground outside of the building, and at an elevation lower than that of the engine, so that surplus oil will return to the storage tank by gravity. There should be no open pit around the storage tank, since gas may accumulate in such a pit and an accident occur to some thoughtless, careless or uninformed person.

Ventilation Essential

By W. A. Radspinner
Superintendent Fire Prevention, Chesapeake & Ohio, Richmond, Va.

As a preliminary to my answer, may I quote from the Good Practice requirements of the National Fire Protection Association, for the installation and use of internal combustion engines:

"Engines * * * * shall be installed only in well-lighted and ventilated sections of buildings, in a location that will permit ready access to parts for repair, cleaning or replacement.

"Stationary engines shall be installed on solid foundations not likely to permit sagging of fuel, exhaust or oil piping and injury to parts, resulting in leakage at joints. Wherever practicable, they shall be located on the ground floor.

"In workshops or rooms where flammable dust or flying prevail, stationary engines shall be enclosed in a suitable compartment, preferably of fire-resistive construction, well ventilated to the outer air at floor and ceilings.

"If located on a wooden floor, the surface under and including 24 in. beyond the engine, shall be covered with metal."

It is essential that rooms containing gasoline or oil engines be ventilated. This should be done by natural means, so far as possible, vents piercing the outside walls being placed at the levels of both the floor and ceil-

ing. As many outside windows as practicable should be provided.

If artificial ventilation is necessary, intakes should be provided at floor and ceiling, and the discharge should be above the roof. Corners should be ventilated to eliminate the formation of pockets of vapor.

Roller Expansion Bearings

What are the advantages and disadvantages of lubricating roller expansion bearings on steel bridges? What form of lubricant should be used?

Requires Precautions

By T. W. Pinard
Engineer of Bridges and Buildings, Pennsylvania, New York

It is of decided advantage to lubricate roller expansion bearings on steel bridges, provided proper provision is made for retention of the lubricant by means of a weatherproof box. I do not believe, however, that expansion rollers should be lubricated unless some means is provided for retention of the lubricant. The lubricant should, preferably, be a grease rather than a light oil. Experience has shown that where a light oil is used and water is allowed to get into the receptacle, there is likely to be leakage of the oil out and over the masonry.

Cleanliness Is Important

By General Inspector of Bridges

This has been a moot question on more than one road. In the older designs of roller expansion bearings, in which the rollers are merely confined in an open rectangular frame and are exposed almost completely to the weather there is no advantage in attempting to lubricate them. On the other hand, there may be a decided disadvantage in doing so. Among the reasons for this, either a light or a heavy oil is effective for only a short time owing to deterioration from exposure.

An application of oil is certain to take on a gummy aspect as it is drying out and it will then catch and hold all sorts of foreign matter, such as cinders, front-end screenings, particles of coal, sand, dust and other forms of dirt and grit. The difficulties of using grease in an open roller nest are obvious, and even if it could be done successfully, the same objections would apply to this lubricant with greater force than to oil.

One of the most serious difficulties we encounter with the open roller nests is that of keeping them clean. Apparently we are not alone in this as I have observed the same conditions on several other roads. This is not due to indifference or neglect, however, but to the inherent conditions under which the expansion bearings must operate. If this is true for dry rollers, the trouble will be greatly increased by the presence of oil or grease. For these reasons we do not attempt to lubricate our open roller bearings, and so far we have experienced little difficulty in obtaining the proper expansion movement of the spans.

From a mechanical viewpoint, any bearing designed to provide for movement between two parts of a device should be lubricated. On this basis we have provided the roller expansion bearings for some of our recent bridges with a weatherproof protection for the roller nest. We are thus able to lubricate the rollers and at the same time keep them clean. I am convinced that there is a distinct advantage in lubricating expansion rollers where deposits of dirt and grit can be prevented and the lubricant protected against the deterioration which occurs where it is exposed openly to the sun and weather. Oils are not suitable as lubricants, but grease gives good results.

Building Inspection Reports

Should the report of the annual building inspection show all of the repairs that should be made, or only those that are imperative? Why?

Should Show Everything

By L. G. Byrd
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

It is our practice, when making annual inspections, to cover bridges, buildings and other structures, including those of the water-service department. Our reports show all repairs that should be made during the following year to place the structures in such condition that, except for emergencies, they will require no further attention for several years, except those minor running repairs, such as broken glass, damaged locks or defective door checks.

In general, we do not expect to carry out all of the work included in the report, as we find it more economical to work out of face, completing all necessary repairs as we go and care for the imperative repairs at other points, distributing our appropriation carefully to permit this. It is both important and convenient, however, to make a separate set of notes covering small items that require immediate attention, which cannot well be carried over into the following season, such as defective steps, roof leaks, damaged doors, windows and locks, defective flues and heating equipment, etc.

If the inspection report does not include all repairs, together with an estimate of the cost of material and labor, it would be incomplete, and under our system of monthly appropriations, the proper allocation cannot then be made to buildings for which the record is incomplete. In other words, if repairs amounting to $600, including painting, are needed, but only those that are imperative, amounting to $400, are shown, it could not be expected that $600 would be appropriated. It is our practice to list all items needing attention, and work up a bill of material and the cost of labor and material while still at the site of the structure.

Report Items in Advance

By A. L. Sparks
Architect, Missouri-Kansas-Texas, St. Louis, Mo.

A common failing of humanity is to defer till tomorrow what should be done today. This trait, so far as it affects railway maintenance, has been fostered somewhat by restricted appropriations during the last few years. In addition, building officers have seen one facility after another, which in former years was considered an absolute necessity to operation, abandoned and forgotten, so that there is a tendency to wonder whether maintenance cannot be deferred on others, and doubtless this has been done in many cases. Indifference of this sort may, however, result in accumulated potential costs out of all proportion

to what would have been necessary for reasonable current maintenance.

In view of these conditions, future operating and replacement costs should be constantly in mind, despite restrictions on present expenditures. To the end that those who apportion maintenance allowances shall be fully informed, all items of approaching expense should be anticipated and reported as far in advance as possible. Some items, as painting, can be deferred from year to year with no greater penalty than the shortening of the service life of the structure. This cannot be done in the case of buildings containing complicated and expensive machinery, such as elevators or other heavy equipment, without running the risk of a complete breakdown and the necessity for costly emergency repairs. A built-up roof may have given perfect service for so many years that the supervisor has almost forgotten its existence. When the end of its life approaches, however, trouble may start and the expense of maintaining it until the date of renewal should be foreseen and included as a prospective item of expense. An inspection report is particularly helpful if a notation is made showing what items can be deferred without risking failure.

How Much Longer Will a Tie Last?

How does one determine whether a tie will last for only one year? For two years?

Opinion Will Vary

By H. S. Talman
Supervisor of Track, Chesapeake & Ohio, Thurmond, W. Va.

It is difficult to inspect a tie and say definitely that it is good for only one year or that it will last two years. Opinion on this point will often vary, as between two qualified and experienced tie inspectors or two section foremen. Before condemning a tie, certain factors can be taken into consideration. Probably the most important of these is the condition of the adjacent ties and of the remaining ties in the panel. If these ties are good there should be no bad results from leaving in a questionable tie for another year. If, on the other hand, the remaining ties are not particularly good, the questionable tie should be removed.

The next consideration is whether the tie in question is a joint tie. Questionable joint ties should always be removed. The next factor bearing on the possible removal of the tie is whether it is on tangent or curve and whether it is tie plated. If the tie is on a curve and is not in condition to do its full share in holding the track to gage, it should be removed. If it is on tangent and the other conditions which have been mentioned are favorable, I would leave it in place. Again, consideration should be given to the probability that the track will be ballasted or given a general raise during the next or the second year. In ballasting, all ties which will not last more than two years should be removed.

If the average life of treated ties is 20 years, and we can safely assume that it is, then the yearly cost of the tie will range from $0.05 to $0.10. Taking out ties while surfacing, which will not last more than two years, will cost the railway from $0.10 to $0.20. In either case this is less than the actual out of pocket cost of digging them in later, while the necessity for disturbing the track at a later date will be eliminated. Finally, the density and speed of traffic will have a definite influence on the decision as to whether the tie should be taken out or left in. If all of these factors are given the proper weight they will aid in determining whether a tie should come out now, next year or not for a period of two or more years.

A Matter of Judgment

By L. H. Harper
Superintendent Creosote Plant, Central of Georgia, Macon, Ga.

Many conditions must be considered in determining how soon a tie should come out of the track. Among these are the importance of the track; the type, weight and speed of trains; and the alinement and the kind of ballast. It is obvious that a tie that is considered to be unfit for further service on a sharp curve in a high-speed main track, may give several years additional service in an unimportant siding where the standard of maintenance is naturally lower, or even in the main track of a branch line.

Another thing to consider is the condition of the ties adjacent to the one in question. Sometimes an isolated tie which is near the point of failure can be safely left in the track for several years, provided there is good timber on both sides of it, whereas it would be necessary to remove it if the adjacent ties are not so sound.

In general, the actual decision is a matter of judgment, based of course, on experience and a knowledge of the local conditions, the exceptions being where shattered, completely decayed or broken ties occur. For these reasons the only general rule that can be stated is that whenever a tie, by reason of mechanical destruction or decay is no longer performing its function to a reasonable degree, and its continued use might render the track unsafe, it should come out.

Must Have Experience

By W. H. King
Section Foreman, Missouri Pacific Lines, Francitas, Tex.

When examining ties to select those which will last only one more year, it is a fairly safe practice to give attention only to the worst looking ones, although this is not an infallible rule for the reason that ties that are made from some woods and that appear to be sound on the outside, will be found, on closer examination, to be badly decayed in the center. This is true particularly of gum ties which, under extreme conditions, may have only a thin outer shell of sound wood, and sometimes the only sound wood left in the tie is on the top.

To determine whether a tie will last two years requires a closer and more critical examination. In this case every tie that shows signs of approaching failure should be sounded thoroughly with a timber bar—a tool with which every tie inspector should be provided. Any inspector on any section of track will find many border-line cases, whether the inspection is being made to select ties that are good for two years or only one additional year. In these cases, other considerations may be as important as the actual physical condition of the tie, so that the density and speed of traffic, the general tie condition, the alinement and other factors must not be ignored, including the kind of wood in the tie.

For these reasons only a man experienced in track work, who has a thorough knowledge of tie timbers and their performance, should be permitted to inspect ties for renewal. Even when the inspector has these qualifications, however, the gang that makes the renewal is quite likely to find that some of the ties that have been marked can be left in while some of the unmarked ones are in such condition that they must be renewed.

Requires Experience

By W. H. Sparks

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Probably no subject relating to track maintenance is more controversial than that of how much longer a tie which is close to the end of its service life will last. This statement does not apply to ties in which failure is already apparent, but to those border-line cases which are found so frequently in ties that are closely approaching but have not actually reached the point of renewal. If only one tie that still has an additional year of useful life remaining is taken out, the road has lost only a negligible amount. But when this sum is multiplied by the total number of ties that might have been allowed to serve another year, the amount of money involved is by no means negligible.

For these reasons, it is of prime importance that the ties for renewal be selected with the utmost care, always keeping three things in mind,—first, that safety is paramount; second, that a tie that is removed before its useful life is ended represents a definite loss, and third, that a tie that is allowed to remain in the track beyond its useful life may result in later maintenance costs that are greater than the loss occasioned by removing a questionable tie. This brings us to the original question of how one can determine whether a tie will last one or two years.

In the first place, one cannot make an intelligent tie inspection unless he is an experienced trackman and is familiar with the conditions surrounding the ties in question. These include the character and density of traffic, the speed of trains, the alinement and general track conditions, the woods being used for tie timber and other factors.

For instance, a tie that must come out on a relatively sharp curve might have lasted one or two more years if it had been on tangent, or even longer on a line of light traffic and lower speeds. A questionable tie may often last another year, or perhaps two years, if the adjacent ties are sound, while it might not be suitable for further service if the adjacent ties are also nearing the end of their service. Ties ahead of frequently-used turnouts should be examined critically, for one cannot afford to maintain questionable ties at such points. Ties along passenger platforms should not be allowed to remain in place after they begin to show signs of deterioration, although they may be safe for several years to come. Joint ties, too, must be given particular attention, for much damage to the rail may result from failure to maintain sound timber at this point.

While many other details could be mentioned, such as the bearing ability of the tie, splitting, spike cutting, decay, rounded corners and the desirability of sounding with a timber bar, enough has been said to indicate quite clearly that no definite rule can be laid down, which can be followed in determining the probable life of questionable ties. The whole matter resolves itself, therefore, into a question of the experience and judgment of the inspector and of his knowledge of the various tie timbers and their performance in service.

Piles and Sliding Embankments

Under what conditions are piles effective in stopping slides on embankments? Where should they be driven? Why? Should they be driven straight or on a batter? Why? If the latter, how much?

Bulkhead Not Needed

By H. T. Livingston

Division Engineer, Chicago, Rock Island & Pacific, Little Rock, Ark.

The use of piling to support the roadbed permits early resumption of service when a line is broken as a result of slides or partial removal of the embankment from other causes. They may be used with good results on embankments constructed of material of low supporting value, especially where satisfactory material is not readily available. They may also be used in case of erosion or slides on side-hills.

They should be driven 10 to 12 ft. from the center of the track in pairs that stand at right angles to the center line, thus permitting them to be connected with rods not less than 1½ in. in diameter. Pairs can be spaced from 2 to 8 ft., depending on the stability of the roadbed material. They should be driven vertically and, where practicable, not less than 4 ft. into the original ground. Bulkhead timbers need not be placed as the forces which the piles must resist are below the limits of any ordinary bulkhead construction.

In stable material, the horizontal component of these forces is resisted by the weight and cohesion of the material between the centerline of the roadbed and the slope. Unstable materials, or those which become unstable when wet, do not afford this reaction and the distance between the piling on either side of the track must accordingly be determined as a matter of experience and judgment.

It is usually preferable to replace unstable material, but some locations, such as near bridge ends or where excessively long hauls are necessary, may make such replacement uneconomical. Embankments to a height of 30 ft. have been stabilized with creosoted piling, properly driven and connected with rods, to such an extent that costs for lining and surfacing track have been reduced to the level of those on fills of similar height, constructed of satisfactory material.

Does Not Favor Piling

By Engineer Maintenance of Way

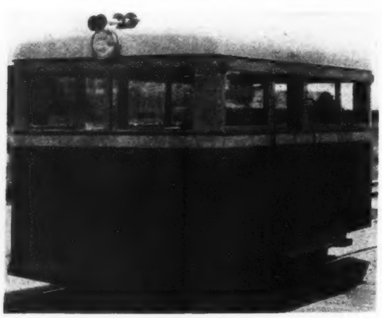
As an emergency measure to provide quickly for the resumption of traffic, the use of piling in connection with sliding embankments may be, and often is, justified. I do not favor it as a permanent form of protection, because it only overcomes the symptoms without removing the basic cause of the trouble. When embankments slide, it is certain that water is at the seat of the trouble, and the only sure cure is to get rid of the water. While this is a simple way of stating it, the elimination of the water may be a long, difficult and costly process. For this reason, piling can sometimes be used effectively, but as a temporary expedient, to protect the track until the drainage project, or other form of correction, has been completed.

I have never known a case where it seemed advisable to drive the piles on a batter, when used for this purpose. In my experience, they have given best results when driven vertically in pairs which were tied together across the track at an elevation slightly above the subgrade, with rods of sufficient size to hold them in this position. They should be driven approximately at the shoulder line, at intervals which will depend on the mobility of the roadbed material and the depth of the slide. A waling piece, of, say, 6 in. by 8 in. material placed outside of the line of piling, will assist in holding the row of piling in line and also eliminate the splitting of the piles, which sometimes occurs as a result of heavy pressures, when it is omitted.

New and Improved Devices

Fairmont Develops New Rail Coach

FAIRMONT Railway Motors, Inc., Fairmont, Minn., has placed on the market a new rail coach for use by official inspection parties, known as Model 3100, which supersedes Models 2000 to 2300 and which embodies many features of the larger models (4100, 5100 and 6100) that are manufactured by this company. The seating capacity of the new unit varies from



The Fairmont 3100 Rail Coach

6 to 11 passengers, including the driver, depending on the type of seats.

The coach has an over-all length of 15 ft. 6¼ in., an over-all width of 8 ft. 5 in., and an inside headroom of 5 ft. 6 in. Any desired grade of body construction can be furnished, and for railroads preferring to build the coach body in their own shops, the bare chassis is supplied with front and rear headlights, horn, self starter and storage battery.

Features of the coach that are designed to provide easy riding include a long spring base, the distance center to center between the front and rear springs being 128 in., and 8¼-in. coil springs 18-in. long with the 4-in. travel damped by "two-way" shock absorbers.

The power unit may consist, as desired, of either a six-cylinder Waukesha 72-hp. engine with a four-speed transmission, or a Ford V-8 engine of 75 to 90 hp. with a three-speed transmission. The exhaust is silenced by a heavy-duty automotive muffler. All transmission speeds are available backward as well as forward in order that, if necessary, return trips may be made without turning the coach around.

The drive is by propeller shaft to a new type reverse and reducing gear on the rear axle. Only four gears of liberal capacity are required, which are mounted on six Timken bearings and two Hyatt bearings with solid rollers. The axles are 2 7/16 in. in diameter and are housed in Timken journal boxes. Demountable wheels, 20 in. by 7/16 in., with Davis heat-treated tires are used. Sufficient brake pressure to slide all four wheels is said to be easily applied by a foot pedal or a 32-in. lever.

Warning signals are produced by matched pair electric horns which resemble in the sound made the pneuphonic air horn commonly used on gas-electric motor trains.

Linde Develops New Welding Torch

A NUMBER of refinements in design and operation have been incorporated in a new welding torch, known as the Purox No. 35 general-duty welding torch, which has been

The Purox No. 35 General-Duty Welding Torch

developed by the Linde Air Products Company, New York. The range of usefulness of this torch is said to make it equally adaptable to the lightest as well as the heaviest work. A special feature of the new torch is the handle, which is of extruded brass with ferrule-type connections that extend parallel to the axis of the handle. The individual mixers in each welding head have been so designed as to afford the maximum resistance to flash-back, while at the same time the effective range of each size tip is said to be greatly increased so that 9 tips perform the functions of the usual 15.

The seating surfaces in the new torch are of Monel metal and are readily removable for cleaning or replacement. In order to permit the welding head to be assembled in the most convenient position relative to the body of the torch, a hexagonal socket arrangement is provided. It is pointed out that this feature also acts to prevent the damaging of the seating surfaces by scoring or otherwise. The welding tips are made of hard-drawn copper.

New ½-Yd. Excavator

THE LINE of American Gopher excavators manufactured by the American Hoist & Derrick Co., St. Paul, Minn., has recently been augmented by the addition of a ½-yd. crawler-type shovel-crane-dragline, known as Model 350. This unit, which embodies recent advances in excavator design, is available with either gasoline, Diesel or electric power.

As a shovel, the unit is fitted with a two-piece welded dipper stick 12 ft. 6 in. long, a welded steel boom 17 ft. 4 in. long, and a manganese steel dipper with renewable and reversible tooth points. It is provided with an independent chain crowd having a return speed that is said to be twice that of crowding. A rope crowd may be furnished if desired. When used as a clamshell crane or dragline crane, the Model 350 is fitted with a parabolic type boom of riveted lattice-angle construction, which is available in 30-ft., 35-ft., and 40-ft. lengths.

Other features of the new excavator include shafts and gears of heat-treated nickel-chromium steel; continuous chain treads of cast manganese carbon steel with multiple type hinge

pins and self-cleaning end sprockets; a machinery deck consisting of a one-piece steel casting; twin hoisting drums of the skeleton type with removable cast steel grooved lagging; a self-locking two-speed boom hoist with an automatic brake for additional safety; a fully-enclosed steel cab

The New American Gopher ½-yd. Excavator

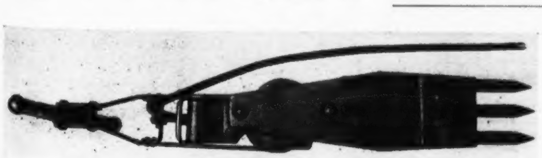
with windows, giving a full view of the work with the operator in either the sitting or standing position; splined and independently removable shafts; friction clutch and brake surfaces of east nickel iron; self-alining ball bearings on all high-speed shafts; and a tail swing of only 8 ft. The Waukesha gasoline engine used is a four-cylinder unit developing 53-hp. at 1,000 r.p.m. An electric starter is provided.

The traveling speeds of this machine are 1.75 miles per hour in high gear and 0.7 mile per hour in low gear, while the slewing speeds are 5.15 and 2.1 r.p.m., respectively.

Ballast Pick for Jackson Tamper

WITH a view to broadening the applications and usefulness of its Jackson tie tamper, the Electric Tamper & Equipment Company, Ludington, Mich., has brought out an accessory blade which is designed principally to be used for the loosening and cleaning of ballast where the latter must be penetrated to depths of 12 or 14 in. This bar consists of a tamping blade of conventional shape which is fitted with three alloy-steel tines pointed at their lower ends. The tines are held to the back of the tamper blade by means of two bolts through a transverse clamping bar which is formed to accommodate the tines. With this design the tines can be adjusted for wear and for various depths of ballast, and can be readily renewed or redressed.

It is said that the high-frequency vibratory action of the pick causes coal dust, clay or dirt to separate from the ballast quickly, and that the tool is especially adaptable to the improvement of drainage in the ballast section. It is also claimed that the use of this tool will largely eliminate the necessity of removing the ballast from the cribs. Another application is in the removal of ice from flangeways. In this work the outside tines are raised to a position where they will not interfere with the operation and the center tine is so adjusted that the lower edge of the tamper blade will engage the top of the rail and crossing planks or other material when the point of the center tine rests on the bottom of the flangeway being cleaned.



The New Ballast Loosening and Cleaning Blade

Buda Announces New Type Tie Tamper

A NEW design of tie tamper which incorporates a new principle in tie-tamper design has been announced by the Buda Company, Harvey, Ill. In this tamper a piston is forced downward against the tamper bar by the action of compressed air. However, instead of using compressed air from an outside compressor, the air is compressed in the tamper itself. This function is carried out by a mechanically-actuated impeller which forces the piston upward in the cylinder in such a manner that air, drawn into the cylinder through an air inlet, is compressed at the top of the cylinder, thus forcing the piston down onto the tamper bar.

The impeller may be actuated either by an electric motor mounted on the tamper or through a flexible shaft from a gasoline engine. The generator sets used in connection with the tampers are made in sizes to drive 2, 4, 8 or 12 tamping tools. These generators, which supply 3-phase, 60-cycle, 110-volt power, are provided with a roller at each end so that the unit can be readily moved along a rail.

Where the tampers are to be used in two-tool outfits for spot tamping, the power unit used consists of a 1¼-hp. air-cooled, gasoline engine which is pivoted on a small pneumatic-tired wheel-barrow. The power is taken

The New Buda Tie Tamper

from the engine by a dual-friction drive, each tamper being connected to the engine by a flexible shaft 8-ft. long. The two types of power are interchangeable so that either the electric motor or the flexible shaft may be connected to the tamper.

New Book

A.W.P.A. Proceedings

PROCEEDINGS of the American Wood-Preservers' Association for 1935. 390 pages, 6 in. by 9 in. Illustrated. Bound in cloth. Published by the association, 1427 Eye St., N.W., Washington, D.C. Price, $6.

Thirteen papers and the same number of committee reports, together with the discussions that followed their presentation are incorporated in this volume of the Proceedings. These papers and reports cover various phases of the treatment of wood to resist decay and destruction by insects and marine borers and to reduce inflammability as well as the use of treated wood for specific purposes.

Subjects of particular interest to railway men include reports on Tie Service Records, on Marine Piling Service Records and on the Use of Creosoted Wood in Buildings; and papers on Treated Timbers in Port Structures in New York Harbor, Decay and Marine Borer Resistance of Creosoted Piles in Tide Water, Experience of the Southern Pacific with Treated Timber in Bridge Construction, Experience of the Chicago, Burlington & Quincy with the Treatment of Crossties, and Fire-Retardant Wood for Fire Doors. Many of the other reports and papers also contain information of value with respect to the use of treated wood on the railways. An unusual feature is a list of patents for wood preservatives issued in Europe, America and Japan since 1914. Included in this volume, also, are the annual statistics on the quantity of wood treated and preservatives used in the United States during 1934.

News of the Month . . .

P.W.A. Railroad Loans

Of the $199,708,000 that has been allotted by the Public Works Administration to railroads, $25,779,326 was for rail and fastenings and the balance of $173,928,674 was for other purposes, principally equipment construction or rehabilitation. Up to August 1, 1935, the Public Works Administration had actually advanced $181,366,500 of the allotted sums. The P.W.A. sold to the Reconstruction Finance Corporation $67,276,500 of the securities for the railroad loans, of which $18,612,000 were subsequently resold to the public, $5,076,000 redeemed and $43,488,500 were held on August 1.

Nation-Wide Truck Line Organized

A nation-wide co-ordinated motor transport organization, known as the Keeshin Transcontinental Freight Lines, has been formed by J. L. Keeshin, president of the Keeshin Motor Express Company, Chicago, and associates. It is expected that operations of the new company will begin about October 15. While long-distance hauling will be its principal business, it will maintain storedoor pick-up and delivery service on all lines and branches. It is proposed to offer fifth morning delivery on shipments from Chicago to the Pacific Coast. The new company will co-operate with any railroad wishing to establish co-ordinated railroad-highway service.

Propose Merging of Three Western Lines

Consolidation of the Chicago, Rock Island & Pacific, the St. Louis-San Francisco and the Chicago & Eastern Illinois is proposed in a plan presented to the Interstate Commerce Commission and the federal district court at Chicago on August 30, by the protective committee of the Rock Islands 6 and 7 per cent preferred stockholders. All these lines have filed petitions for reorganization under Section 77 of the amended bankruptcy act, and this is the first proposal to be submitted by stockholders of any of the lines. The acceptance of this proposal would result in the creation of a 15,000-mile system having a total capitalization of about $800,000,000.

Alabama Gets Funds for Grade Separation

President Roosevelt has approved an allotment of $1,342,010 of works program funds previously apportioned by the Secretary of Agriculture to Alabama for the elimination of hazards at grade crossings in 9 of 67 counties in the state. The total apportionment to Alabama under the $200,000,000 allocation for grade crossing elimination projects in the 48 states is $4,034,617; thus a balance of $2,292,607 remains, which will be covered by later application. The grade crossing elimination program in the nine counties involved will include the reconstruction of 3 existing grade separation structures and the elimination of 19 grade crossings by the construction of 11 grade separation structures at various points.

Rail Income Lower in July

For July the Class I railroads of the United States had a net railway operating income of $26,851,397, which for that month was at the annual rate of return of 1.16 per cent on their property investment, as compared with a net railway operating income of $35,441,265, or 1.53 per cent, in July, 1934, according to reports filed by the carriers with the Bureau of Railway Economics of the Association of American Railroads. Gross operating revenues for July amounted to $275,349,115, as against $276,009,904 in July, 1934, a decrease of 0.2 per cent. Operating expenses in July totaled $217,903,698, as compared with $208,492,883 in the same month in 1934, an increase of 4.5 per cent.

For the first seven months of the year these roads had a net railway operating income of $221,664,055, which was at the annual rate of return of 1.69 per cent, as compared with $262,308,288, or 1.99 per cent, in the comparable period of 1934. Gross operating revenues for the first seven months amounted to $1,910,943,435 compared with $1,905,907,005 for the same period in 1934, an increase of 0.3 per cent. Operating expenses were $1,477,393,366 as compared with $1,420,779,947 in 1934, an increase of 4.0 per cent.

Eight Roads Would Take Over M. & St. L.

An application requesting permission to acquire the railroad properties of the Minneapolis & St. Louis, to abandon certain portions, to operate certain portions and to dispose of certain other portions to the participating railroads has been filed with the Interstate Commerce Commission by the Associated Railways Company, a Delaware corporation recently formed by eight railroads. These include the Chicago & North Western, the Chicago, Burlington & Quincy, the Chicago Great Western, the Chicago, Milwaukee, St. Paul & Pacific, the Chicago, Rock Island & Pacific, the Great Northern, the Illinois Central and the Minneapolis, St. Paul & Sault Ste. Marie. The new company plans to acquire control of the M. & St. L. at a foreclosure sale, following which it would convey to the several participating carriers the parts of the line previously assigned to them. The North Western would get 140 miles solely and 99 miles jointly with the Illinois Central and 21 miles jointly with the Rock Island; the Burlington would get 197 miles; the Great Western (or Milwaukee) 429 miles; the Rock Island 92 miles; and the Great Northern 47 miles. It is proposed to abandon a total of 507 miles of the Minneapolis & St. Louis.

Freight Damage Shows Increase

Freight loss and damage payments during the first six months of 1935 increased 6.9 per cent, as compared with the same period in 1934, or from $7,960,214 to $8,510,291, according to figures compiled by the Freight Claim division of the Association of American Railroads. Loss and damage to fresh fruits, melons and vegetables amounted to $2,483,169 in the first six months of 1935, as compared with $2,326,987 in the corresponding period of last year, an increase of 6.8 per cent. Claims received totaled 851,493.

New Equipment Installed

New freight cars installed by the Class I railroads in the first seven months of 1935 totaled 2,272, according to the Association of American Railroads. In the same period last year, 9,483 new freight cars were placed in service, and, in the same period two years ago, there were 1,391. Twenty-seven new steam locomotives and 99 new electric locomotives were placed in service in the first seven months of this year. In the first seven months of 1934, six new steam locomotives and eight new electric locomotives were installed.

New freight cars on order on August 1 totaled 2,174 compared with 13,755 on the same day in 1934 and 1,187 in 1933. Four new steam locomotives and four new electric locomotives were on order on August 1, as compared with 35 steam locomotives and 107 electric locomotives on order on the same date last year.

Chicago-Twin Cities Trains Handle Record Business

The high-speed trains of the Chicago, Burlington & Quincy, the Chicago, Milwaukee, St. Paul & Pacific and the Chicago & North Western handled a record number of passengers between Chicago and the Twin Cities over the Labor Day week-end, necessitating the operation of extra sections. The twin Zephyrs of the Burlington were operated to capacity on each run, and on August 31 a steam train was operated as a second section southbound, carrying 143 passengers. The Hiawatha of the Milwaukee was operated in two sections, both north and southbound, on August 30 and 31 and September 1 and 2, while on August 31 it was operated northbound in three sections. The five sections on August 31 carried 1,603 on-and-off passengers. The Four Hundred of the North Western was operated in two sections, northbound on August 30 and September 2, while extra cars were added to all sections on each day from August 29 to September 2.

Association News

Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club will be held at 6 p.m., on October 17, at the Hotel McAlpin, New York City. The speaker will be C. H. R. Howe, cost engineer of the Chesapeake & Ohio, who, on the basis of experience on the C. & O., will discuss the uses of motion pictures in the promotion of standard practices for track work.

American Railway Engineering Association

The 1935 Proceedings is now being bound and will be mailed to members early in October. This year's volume contains 1,170 pages as compared with 1,214 in 1934. Bulletin 378 containing the supplement to the Manual will also be in the mail shortly.

In addition to the general committee of the engineering division, which held a meeting in Chicago on September 5, seven committees held meetings during the month as follows: Maintenance of Way Work Equipment, on September 17 and 18, at Chicago; Highways, on September 18, at Chicago; Track, on September 18, at Chicago; Buildings, on September 18, at New York; Roadway, on September 18 and 19, at Chicago; Economics of Railway Labor, on September 19, at Chicago; and Water Service, Fire Protection and Sanitation, on September 23 and 24, at Chicago.

Four committees have scheduled meetings for October, these being Iron and Steel Structures, at Philadelphia, on October 3 and 4; Wood Preservation, at Chicago, on October 3; Wooden Bridges and Trestles, at Chicago, on September 18. The Committee on Ties will meet at Duluth, Minn., on October 8 and continue its meeting at St. Paul, on October 9.

Bridge and Building Association

The program has now been completed for the forty-second annual convention, which will be held at the Hotel Stevens, Chicago, on October 15-17, and indications point to a large attendance. All of the committees have now completed and transmitted their reports to Secretary C. A. Lichty, and they are now in the hands of the printer. The program is as follows:

Tuesday Morning
October 15

Convention called to order 10 a.m.
Invocation
Opening address by H. G. Taylor, chairman, Western Association of Railway Executives, Chicago
Greetings from the American Railway Engineering Association, by R. H. Ford, president (assistant chief engineer, C.R.I. & P.), Chicago
Greetings from the Roadmasters Association, by Armstrong Chinn, vice-president (chief engineer, Alton), Chicago
Address of President H. I. Benjamin
Appointment of special committees and announcements
Report of Committee on Cleaning of Steel Bridges Preparatory to Repainting, E. C. Neville, chairman (B. & B. master, Can. Natl.), Toronto, Ont.

Tuesday Afternoon
(2:00 p.m.)

Report of Committee on The Inspection of Bridges and Buildings in the Light of Today's Deferred Maintenance, D. T. Rintoul, chairman (general bridge inspector, S.P.), San Francisco, Cal.
Address on Recent Developments in the Application of Welding to Railway Bridges, by A. R. Wilson, engineer bridges and buildings, Eastern Region, Penna., Philadelphia, Pa.
Report of Committee on The Use of Treated Timber in Buildings, L. C. Winkelhaus, chairman (architect, C. & N.W.), Chicago
Adjournment to visit exhibit of Bridge and Building Supply Men's Association.

Tuesday Evening
(7:30 p.m.)

Address on Trends in Bridge Design, Erection and Maintenance, by C. Earl Webb, division engineer, American Bridge Company, Chicago

Wednesday Morning
(9:00 a.m.)

Report of Committee on The Welding of Pipes in Water Supply, Plumbing, etc., C. M. Burpee, chairman (research engineer, D. & H.), Albany, N.Y.
Address on Making Timber Bridges Last Longer, by I. L. Simmons, engineer of bridges, C.R.I. & P., Chicago
Report of Committee on Types of Floors for Highway Bridges Under Various Service Conditions with Relation to Durability, Character of Sub-floor Required, Cost and Surface Characteristics, T. H. Strate, chairman (division engineer, C.M.St.P. & P.), Chicago
Report of Nominating committee

Luncheon
(12:30 p.m.)

Address by executive officer of a prominent railway

Wednesday Afternoon
(2:00 p.m.)

Report of Committee on Relative Merits of Different Types of Pumping Equipment and Conditions Under Which Each Is Most Suitable, C. R. Knowles, chairman (superintendent of water service, I.C.), Chicago
Address on the San Francisco Bay Bridges and Their Construction, by George W. Rear, engineer of bridges, So. Pac., San Francisco, Calif.
Round table discussion of questions submitted by members.

Thursday Morning
(9:00 a.m)

Report of Committee on Under Water Inspection and Examination of Railroad Structures, W. R. Ganser, chairman (master carpenter, Penna.), Camden, N.J.
Business session

Thursday Afternoon

The afternoon will be devoted to an inspection of the new "Hiawatha," high speed, streamlined steam train of the C.M. St.P. & P., the "Abraham Lincoln", high speed, streamlined steam train of the Alton, the "400", high speed steam train of the C. & N.W., and the "Zephyr", streamlined Diesel train of the C.B. & Q.

Bridge and Building Supply Men's Association

Twenty-two companies have already arranged for participation in the exhibit of bridge and building materials which will be conducted in connection with the convention of the Bridge and Building Association. With other companies that are now negotiating for space it is indicated that at least thirty manufacturers will participate. The companies that have arranged for space to date, according to the secretary, L. F. Flanagan, Detroit Graphite Company, include the following:

Arrow Tools, Inc., Chicago
Binks Manufacturing Co., Chicago
Celotex Company, Chicago
Dearborn Chemical Co., Chicago
Detroit Graphite Co., Detroit, Mich.
Paul Dickinson, Inc., Chicago
Joseph Dixon Crucible Co., Jersey City, N.J.
Duff Norton Mfg. Co., Pittsburgh, Pa.
Fairbanks Morse & Co., Chicago
Fairmont Railway Motors, Inc., Fairmont, Minn.
Ingot Iron Railway Products Co., Middletown, Ohio
Johns-Manville Sales Corporation, New York
Lehon Company, Chicago
Mall Tool Company, Chicago
Earl A. Mann and Associates, Chicago
Massey Concrete Products Corporation, Chicago
National Lead Company, New York
Otley Paint Manufacturing Co., Chicago
Pittsburgh Plate Glass Co., Paint and Varnish Division, Newark, N.J.
Pocket List of Railroad Officials, New York
Railway Engineering & Maintenance, Chicago
Ruberoid Company, New York
Zitterell Mills Co., Webster City, Iowa

Rail Travel to Yellowstone Park

Railroad passenger travel to Yellowstone National Park has shown substantial increases this year as compared with recent years, according to a report issued by the National Park Service of the Department of the Interior. From the beginning of the season through August 15, a total of 11,571 railroad passengers entered the park as compared with 9,270 in 1934, an increase of 2,301 or nearly 25 per cent, and with 3,934 in 1933, an increase of 7,637, or 195 per cent. During the first 15 days of August, 3,579 railroad passengers entered the park, an increase of 892, or 33 per cent, as compared with the same period in 1933. Passengers entering the park from individual railroads up to August 15 of this year included 4,621 from the Union Pacific, as compared with 3,296 in the corresponding period last year; 4,185 from the Northern Pacific, as compared with 3,296; 2,053 from the Chicago, Burlington & Quincy, as against 1,742; and 684 from the Chicago, Milwaukee, St. Paul & Pacific, as compared with 598.

Personal Mention

General

A. T. Summey, senior land appraiser on the Atlantic Coast Line and formerly an assistant engineer with this company, has been appointed real estate agent, with headquarters at Wilmington, N. C.

R. S. Claar, formerly district engineer of the Minneapolis, St. Paul & Sault Ste. Marie, whose appointment as real estate and land commissioner of this road, with headquarters at Minneapolis, Minn., was reported in the September issue, was born on October 24, 1887, at Blair, Neb. Mr. Claar entered railway service in 1905 as a material clerk on construction on the Chicago & North Western at Bonesteel, S. D. After spending two years in the stores department of this road and one year in the stores and freight departments of the Union Pacific he entered Armour Institute at Chicago. Following his graduation in 1912, Mr. Claar entered the service of the Chicago, Milwaukee & Pacific as a bridge designer. In October, 1912, he went with the Duluth, South Shore & Atlantic, where he served successively as inspector on bridge and building construction, engineer of construction and office engineer. From February, 1919, to May, 1930, he was district engineer on the Chicago district of the Soo Line, then being advanced to right of way and real estate agent, which position he held until his recent promotion.

George C. Jefferis, assistant superintendent on the Middle division of the Atchison, Topeka & Santa Fe, and formerly a division engineer on this road, has been promoted to superintendent of the Slaton division, with headquarters at Slaton, Tex. Mr. Jefferis was born on September 27, 1889, at Philadelphia, Pa., and entered railway service on June 4, 1903, as a telegraph operator on the Pennsylvania. After eight years with this company he went with the Santa Fe as a chainman at Amarillo, Tex., and served successively in this position and as a rodman, transitman, draftsman, assistant extra-gang foreman, and extra-gang foreman at various points in Texas and New Mexico until August, 1916. In that month he was promoted to roadmaster, with headquarters at Plainview, Tex., and in the following year he was further advanced to division engineer, with headquarters at Clovis, N.M. In February, 1924, Mr. Jefferis was advanced to assistant superintendent of the Middle division, with headquarters at Newton, Kan., which position he continued to hold until his recent promotion to superintendent.

Engineering

W. D. Wiggins, chief engineer of the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been appointed acting chief engineer of the system with headquarters at Philadelphia, Pa., relieving **T. J. Skillman,** who has been granted a leave of absence because of ill health. **W. B. Wood,** engineer, Baltimore Improvements, has been appointed acting chief engineer of the Central region at Pittsburgh to replace Mr. Wiggins.

J. R. Hickox, hydraulic engineer of the Chicago, Burlington & Quincy, with headquarters at Chicago, has retired under the pension rules of this company but will remain with the railroad in a consulting capacity with the law department. The position of hydraulic engineer has been abolished.

Jose I. Boneta has been appointed division engineer of the Southeast division of the National Railways of Mexico, with headquarters at Tierra Blanca, Ver. C., succeeding **A. Polanco,** deceased. **Antonio de Legarreta** has been appointed division engineer of the Central division, with headquarters at Aguascalientes, Aguas., succeeding **L. Reyna.**

Track

A. S. Boulding, a track foreman on the Canadian National has been appointed acting roadmaster, with headquarters at Radville, Sask., to succeed **T. Dixon,** who has been transferred to Moose Jaw, Sask., where he replaces **G. C. Barnett.** Mr. Barnett has been transferred to Regina, Sask., to replace **C. Story, retired.**

J. W. Peterson, roadmaster on the Dakota division of the Chicago, Rock Island & Pacific, with headquarters at Estherville, Iowa, who has been on a leave of absence, has resumed his duties. **Paul Buser,** who was acting roadmaster at Estherville in Mr. Peterson's absence, has returned to the position of track inspector.

R. W. Adkins, a track foreman on the Eastern division of the Atchison, Topeka & Santa Fe, and formerly a roadmaster on this road, has been reappointed to the latter position, with headquarters at Emporia, Kan., to succeed **J. E. Henderson,** who has retired.

Mr. Henderson was born on November 21, 1867, at Emporia, and entered railway service with the Santa Fe on May 4, 1887, as a section laborer at Clements, Kan., serving in a similar capacity at Lake View, Kan., Lawrence, and Atchison until November 1, 1905, when he was promoted to roadmaster at Topeka, Kan. On April 1, 1915, Mr. Henderson was transferred to Emporia, where he remained until his recent retirement.

Bridge and Building

F. J. Conn, bridge inspector of the Western Lines of the Southern, with headquarters at Lexington, Ky., died in that city on August 9, at the age of 78 years.

J. H. Vosburgh, whose retirement as supervisor of bridges and buildings on the Buffalo division of the New York Central, with headquarters at Buffalo, N.Y., was noted in the August issue, was born on July 6, 1865, at Marshville, N.Y. Mr. Vosburgh entered railway service in 1883 as a carpenter on the New York Central, and in 1890, was promoted to carpenter foreman with headquarters at Syracuse, N.Y. On April 1, 1906, he was further advanced to general bridge foreman on the Mohawk division, with headquarters at Utica, N.Y., and on November 1, 1907, he was promoted to supervisor of bridges and buildings with the same headquarters. On March 1, 1917, Mr. Vosburgh was transferred to the St. Lawrence division, with headquarters at Watertown, N.Y., and on September 1, 1920, he was transferred to the Buffalo division, with headquarters at Buffalo.

J. W. Williamson has been appointed supervisor of building repairs of the Northern division of the Atlantic Coast Line, with headquarters at Rocky Mount, N. C., succeeding **J. M. Finch,** deceased.

Obituary

Frederick P. Gutelius, resident vice-president of the Delaware & Hudson, at Montreal, Que., and formerly assistant chief engineer of the Canadian Pacific, died on September 12 at North Bay, Ont., after a long illness. Mr. Gutelius was born at Miffinburg, Pa., on December 21, 1864, and was educated at Lafayette college (C. E., 1887; Sc. D., 1914). He entered railroad service in 1888 as assistant

Frederick P. Gutelius

engineer for the Pennsylvania lines west of Pittsburgh, serving in this capacity and in those of assistant on engineer corps and assistant supervisor until 1892. From 1892 to 1894 Mr. Gutelius was engaged in hydraulic engineering and mining surveying at Butte, Mont., and from 1894 to 1895 he was county surveyor of Silver Bow county, Mont. From 1895 to 1898 he was in charge of construction of the Trail Creek Tramway in British Columbia, and general superintendent of the Columbia & Western (now Canadian Pacific). He became division superintendent on the Canadian Pacific in 1898 and in 1902 he was appointed engineer maintenance of way for that road, becoming assistant chief engineer in 1906. Mr. Gutelius served as general division superintendent for the Canadian Pacific at Montreal, Que., from 1908 to 1912. From 1912 to 1913, he was a member of the Canadian Government Royal Commission

to investigate construction of the National Transcontinental Railway and in 1913 he became general manager of the Canadian Government Railways (now Canadian National), which position he held until 1917, when he became vice-president in charge of operation and traffic for the Delaware & Hudson at Albany, N. Y. During the war period he acted as federal manager of the Delaware & Hudson and became resident vice-president at Montreal in 1923.

A. P. Wenzell, a special engineer on the New York Central, with headquarters at Chicago, died at his home in that city on September 22. Mr. Wenzell had been engaged on special assignments out of the vice-president's office and had made a study of the railroad terminal problem at Chicago. He had also served for several years as secretary of the Special Committee on Engineering Research, Inland Waterways and Intercoastal Canals of the American Railway Association.

Large Pile Concrete Trestles—The Portland Cement Association, Chicago, has published a 12-page well-illustrated pamphlet bearing this title, which discusses the advantages and applications of large pile concrete trestles.

Buckets—The Industrial Brownhoist Corporation, Bay City, Mich., has published a 20-page illustrated booklet describing its complete line of rope-reeve, power-wheel, lever-arm and link-type buckets. This booklet, which is known as Catalogue 353, is complete with tables giving capacities, weights, dimensions, etc.

Zeolites.—The Permutit Company, New York City, has issued a 32-page bulletin, prepared by Eskel Nordell of its Technical department, which includes a comprehensive treatise of present practice in the mining, processing, manufacture and use of zeolites. It is said that this is the first detailed paper on this subject that has been published.

Nickel Cast Iron Data—The general physical and chemical properties of nickel alloy cast iron are discussed in a recent publication, entitled Nickel Cast Iron Data, Section 1, Number 5, of the International Nickel Company, Inc., New York. While the subject is treated with particular reference to the special application of nickel alloy cast iron in petroleum production equipment, much of the discussion in the 12-page booklet is of general application.

Welding Electrodes.—Wilson welding electrodes, their metallic composition, physical properties, applications, and welding procedure, form the basis of an interesting and informative catalogue published by the Wilson Welder & Metals Company, Inc., North Bergen, N. J. Included in the catalogue, which contains many illustrations of difficult welding operations, are tables showing the chemical analyses of Wilson electrodes, Wilson electrode numbers and applications, arc voltages, amperes recommended for different diameter electrodes, sizes and weights of electrodes, and amount of deposited metal.

Supply Trade News

Personal

Frank Liebich of the industrial sales division of the **Harnischfeger Corporation,** Milwaukee, Wis., has been appointed district manager in charge of operations in the Detroit area.

J. P. Distler, general manager of sales of the **Keystone Steel & Wire Company,** has been appointed manager of sales, wire division, **Republic Steel Corporation,** with headquarters in Chicago, to succeed **R. W. Hull,** whose duties as assistant manager of sales for all Republic products in the Chicago district will now receive his entire time.

Benjamin F. Fairless, executive vice-president and general manager of the **Republic Steel Corporation,** Youngstown, Ohio, has been elected president of a newly formed organization comprising the

Benjamin F. Fairless

Carnegie Steel Company and the **Illinois Steel Company,** with headquarters at Pittsburgh, Pa. Both companies are subsidiaries of the United States Steel Corporation. Mr. Fairless was born on May 3, 1890, at Pigeon Run, Ohio. He was educated at Ohio Northern university, Ada, Ohio, and Wooster university, Wooster, Ohio. Mr. Fairless entered railroad service in 1912 as a transitman on the Wheeling & Lake Erie at Brewster, Ohio. In May, 1914, he became associated with the Central Steel Company at Massillon, Ohio, and later served as its vice-president and general manager. He was holding the latter position in 1926, when this company was merged with the United Alloyed Steel Corporation to form the Central Alloyed Steel Corporation. Mr. Fairless was made vice-president and general manager of the new company and later its president. When the Central Alloy and other steel companies were absorbed by the Republic Steel Corporation in 1929, Mr. Fairless became first vice-president of the latter company. The plan of unification of the two United States Steel Corporation subsidiaries, which Mr. Fairless now heads, becomes effective on October 1, and is designed to simplify and improve the procedure with respect to production and sales in the Pittsburgh-Chicago district.

G. M. Hanrahan, for the past ten years with the Haskelite Manufacturing Corporation, has been appointed assistant sales director of the Technical Division of the **Algoma Plywood & Veneer Company,** with main office at 228 North La-Salle street, Chicago.

Trade Publications

Barco Tytampers—The Barco Manufacturing Company, Chicago, has published a four-page folder bearing this title in which the Barco Unit Tytamper is described and illustrated.

Preservation With NO-D-K—The Tennessee Eastman Corporation, Kingsport, Tenn., has issued a 16-page illustrated booklet which is devoted to a discussion of the properties, methods of use and applications of this company's NO-D-K wood preservative.

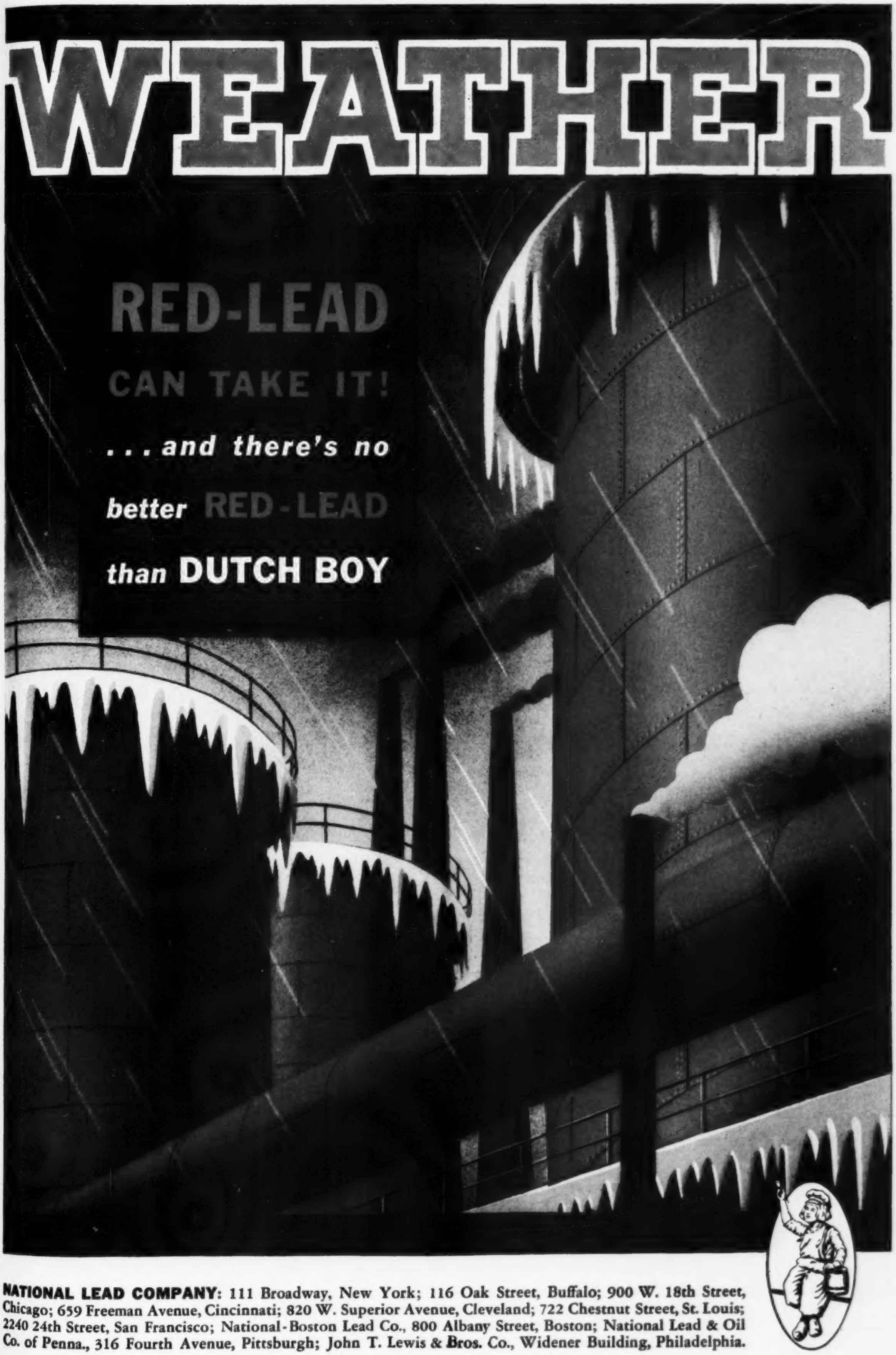
Progress Bulletin on Trackwork Fixtures—The Ramapo Ajax Corporation, New York, has issued an unusually complete and informative 20-page bulletin describing recent improvements in trackwork fixtures developed by this company to meet the demands of higher speed operation. The bulletin includes improvements in switch stands and switch accessories, frogs, crossings and other trackwork devices. Each of these improvements is illustrated with wash drawings, sketches and "cut away" views showing internal construction, and is accompanied with information designed to make the book of practical reference value.

The Metallurgy of Oxy-Acetylene Welding of Steel—The Linde Air Products Company, New York, has published a book bearing this title, which comprises an informative discussion of the physical and chemical principles involved in the oxy-acetylene welding of steel. The booklet was written by J. H. Critchett, vice-president of the Union Carbide & Carbon Research Laboratories, Inc., and covers physical changes, such as expansion and contraction, metallurgical effects such as crystallization, heat-treatment and the effect of alloys, and the chemical reactions of steel with its surrounding materials.

The Osmose Process.—The Osmose Corporation of America, Buffalo, N. Y., has published an eight-page booklet entitled "The Osmose Process for the Preservation of Standing Poles and Piling," which explains how the use-life of poles and piling may be increased by the Osmose process of wood preservation. The booklet also explains the purposes and functions of the various treating compounds used in the Osmose process and describes how the preservatives penetrate the wood by means of the process of osmosis. Another feature of the booklet is a series of illustrations showing how the Osmose compounds are applied in the treatment of standing poles.

ALPHABETICAL INDEX TO ADVERTISERS

and list of their products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